ANTS, BEES, AND WASPS

A RECORD OF OBSERVATIONS ON THE HABITS OF THE SOCIAL HYMENOPTERA

BY

SIR JOHN LUBBOCK, BART. M.P. F.R.S. D.C.L. LL.D.

PRESIDENT OF THE LINNEAN SOCIETY
PRESIDENT OF THE INSTITUTE OF BANKERS
AUTHOR OF 'PREHISTORIC TIMES' 'THE ORIGIN OF CIVILISATION' ETC.
HONORARY SECRETARY OF THE LONDON BANKERS
FELLOW OF THE ENTOMOLOGICAL, GEOLOGICAL, AND OTHER SCIENTIFIC SOCIETIES

SEVENTH EDITION

LONDON
KEGAN PAUL, TRENCH, & CO., 1 PATERNOSTER SQUARE
1885

PREFACE

This volume contains the record of various experiments made with ants, bees, and wasps, during the past ten years; and most of which have appeared in the 'Journal of the Linnean Society,' for the years 1874 to 1882. Other occupations and many interruptions, political and professional, have prevented me from making them so full and complete as I had hoped. My parliamentary duties, in particular, have absorbed most of my time just at the season of year when these insects can be most profitably studied. I have, therefore, whenever it seemed necessary, carefully recorded the month during which the observations were made; for the instincts and behaviour of ants, bees, and wasps are by no means the same throughout the year. My object has been not so much to describe the usual habits of these insects as to test their mental condition and powers of sense.

Although the observations of Huber, Forel, McCook, and others are no doubt perfectly trustworthy, there are a number of scattered stories about ants which are quite unworthy of credence; and there is also a large class in which, although the facts may be correctly recorded, the inferences drawn from them are very questionable. I have endeavoured, therefore, by actual experiments which any one may, and I hope others will, repeat and verify, to throw some light on these interesting questions.

The principal point in which my mode of experimenting has differed from that of previous observers has been that I have carefully marked and watched particular insects; and secondly, that I have had nests under observation for long periods. No one before had ever kept an ants' nest for more than a few months. I have one now in my room which has been under constant observation ever since 1874, *i.e.* for more than seven years.[1]

[1] I may add that these ants are still (August 1882) alive and well. The queens at least are now eight years old, if not more.

I had intended to make my observations principally on bees; but I soon found that ants were more convenient for most experimental purposes, and I think they have also more power and flexibility of mind. They are certainly far calmer, and less excitable.

I do not attempt to give anything like a full life-history of ants, but I have here reproduced the substance of two Royal Institution lectures, which may serve as an introduction to the subject. Many of the facts there recorded will doubtless be familiar to most of my readers, but without the knowledge of them the experiments described in the subsequent chapters would scarcely be intelligible.

I have given a few plates illustrating some of the species to which reference has been most frequently made; selecting Lithography (as I was anxious that the figures should be coloured), and having all the species of ants drawn to one scale, although I was thus obliged in some measure to sacrifice the sharpness of outline, and the more minute details. I am indebted to Mr.

Bates, Dr. Günther, Mr. Kirby, and Mr. Waterhouse, for their kind assistance in the preparation of the plates.

As regards bees and wasps, I have confined myself for want of space to the simple record of my own observations.

I am fully conscious that experiments conducted as mine have been leave much to be desired, and are scarcely fair upon the ants. In their native haunts and under natural conditions, more especially in warmer climates, they may well be expected not only to manifest a more vivid life, but to develop higher powers.

I hope, however, that my volume will at least show the great interest of the subject, and the numerous problems which still remain to be solved.

High Elms, Down, Kent:
October 18, 1881.

CONTENTS.

CHAPTER III.

ON THE RELATION OF ANTS TO PLANTS.

PAGE

CHAPTER IV.

RELATIONS TO OTHER ANIMALS.

CHAPTER V.

BEHAVIOUR TO RELATIONS.

CHAPTER VI.

RECOGNITION OF FRIENDS.

CHAPTER VII.

POWER OF COMMUNICATION.

CHAPTER VIII.

THE SENSES OF ANTS.

CHAPTER IX.

GENERAL INTELLIGENCE.

CHAPTER X

BEES.

CHAPTER XI.

WASPS.

LIST OF ILLUSTRATIONS.

All the figures are enlarged about four times.
The sign ☿ indicates a worker; ♂ a male; and ♀ a queen.

LIST OF THE

PRINCIPAL BOOKS AND MEMOIRS

REFERRED TO.

ANDRÉ, E. . Desc. des Fourmis d'Europe. Rev. et Mag. de Zool., 1874.

BATES, H. W. . The Naturalist on the Amazons.

BELT, T. . The Naturalist in Nicaragua.

BERT, PAUL . 'Les animaux voient-ils les mêmes rayons lumineux que nous?' Arch. de Physiol, 1869

BLANCHARD, E. . Metamorphoses of Insects. Trans. by Duncan.

BOISSIER DE SAUVAGES, l'Abbé. L'origine du Miel. Journ. de Physique, vol. i.

BÜCHNER, L. . Mind in Animals.

BUCKLEY, S. B. . On Myrmica molefaciens. Proc. Acad. Nat. Sci. Philadelphia, 1860.

BURMEISTER, H. . Manual of Entomology.

CURTIS, J. . On the Genus Myrmica. Trans. Linn. Soc., 1854.

DARWIN, C. . Origin of Species.

DELPINO, F. . Sui rapporti delle Formiche colle Tettigometre.

DEWITZ, H. . Ueber Bau und Entwickelung des Stachels der Ameisen. Zeits. f. Wiss. Zoologie, vol. xxviii

DUJARDIN, F. . Obs. sur les Abeilles. Ann. des Sci. Nat., 1852.

EDWARDS, H. . Notes on the Honey-making Ants. Proc. California Acad., 1873.

ELDITT, H L. . Die Ameisen-Colonien u. deren Mitbewohner.

EMERY, C. . Saggio di un ordinamento naturale dei Mirmicidei.

EMERY, C. . . Le Formiche ipogei. Ann. Mus. Civ. di St. Nat. di Genova.
FOREL, A. . . Fourmis de la Suisse.
GÉLIEU, J. DE . . Le Conservateur des Abeilles.
GOULD, Rev. W. . Account of English Ants.
GRÄBER, VITUS . Die Tympanalen-Sinnesapparate der Orthopteren.
GREDLER, V. . . Der zoologische Garten.
GRIMM . . . Die Myrmecophilen. Stettin. Ent. Zeits., 1845.
HAGENS, Herr VON . Ueber Ameisengäste. Berlin. Ent. Zeits., 1865.
" " Ueber Ameisen mit gemischten Colonien. Berlin. Ent. Zeits., 1867.
HEER, O. . . Die Hausameisen Madeiras. Zürich. Nat. Ges., 1852.
HUBER, P. . . Natural History of Ants
HUXLEY, T. H. . On the Reproduction of Aphis. Trans Linn. Soc., xxii. 1859.
KERNER, Dr. A. . Flowers and their Unbidden Guests. Trans. by Ogle.
KIRBY AND SPENCE Introd. to Entomology.
LANDOIS, Dr. H. . Thierstimmen; also Zeits für Wiss. Zool., 1867.
LANGSTROTH, L. L. . Treatise on the Honey Bee.
LATREILLE, P. . . Hist. Nat. des Fourmis.
LESPÈS, C. . . Sur les Mœurs de Lomechusa paradoxa. Ann. des Sci. Nat., 1863.
LINCECUM, GIDEON . On the Agricultural Ant of Texas. Linn. Journal, 1861.
LONG, Col. C. G. . Central Africa.
LUBBOCK, Sir J. On the Anatomy of Ants. Trans. Linn. Soc., 1879.
" . Ova and Pseudova of Insects. Phil. Trans., 1858.
" . Obs. on Ants, Bees, and Wasps. Parts 1–9, Linn. Journ., 1874–81.
" . On Some Points in the Anatomy of Ants. Micros. Soc., 1877.
LUND, M . Lettres sur les Habitudes de quelques Fourmis du Brésil. Ann. des Sci. Nat., xxiii. 1831.

McCook, H. C. Note on Adoption of a Queen Ant. Proc. Acad. Nat. Sci. Philadelphia, 1879.
" . . On the Nat. His. of the Agricultural Ant of Texas.
" . . The Honey Ant of Texas.
Märkel, F. . . Beit. zur Kenntniss der unter Ameisen lebenden Insecten. Germar's Zeit. Ent.. 1841.
Mayr, Dr. G. L. . Europ. Formiciden.
" . . Leben und Wirken der einh. Ameisen.
" . . Myrmec. Studien. Ver. Zool. Bot. Verein in Wien, 1862.
Meinert, F. . . Bidrag til de Danske Myrers Naturhistorie. Kiöbenhaven, Dansk. vid. Selsk., 1861.
Meyer, J. . . Ueber coconlose Ameisenpuppen. Stettin. Ent. Zeit., 1854.
Müller, P. W. J. . Beiträge zur Naturgeschichte der Gattung Claviger. Germar's Mag. de Zool., 1818.
Ormerod, E. L. . Natural History of Wasps.
Rambert, M. . . Mœurs des Fourmis.
Robert, E. . . Observations sur les Mœurs des Fourmis. Ann. des Sci. Nat., 1842.
Roger, J. . . Beit. zur Kennt. der Ameisenfauna der Mittelmeerländer. Berlin. Ent. Zeit., 1857.
St. Fargeau, Lepeletier. Hist. Nat. des Hyménoptères.
Saunders, Edward Brit. Heterogyna and Foss. Hymenoptera. Trans. Ent. Soc., 1880.
Savage, T. S. . On the Habits of Driver Ants. Trans. Ent. Soc., 1847.
Schenk, Professor Beschr. Nassau. Ameisenarten. Stettin. Ent. Zeit., 1853.
Siebold, C. T. von. Ueber das Stimm. und Gehörorgan der Orthopteren. Weissmann's Arch., 1844.
Smith, F. . . Cat. of Brit. Foss. Hymenoptera.
" . . . Essay on British Formicidæ. Trans Ent. Soc., N.S. vol. iii. p. 98.
Sykes, Col. . Account of Pheidole providens. Trans. Ent Soc., 1836.
Wesmael, C. . Sur une nouv. Espèce de Fourmi du Mexique. Bull. de l'Acad. de Sci. de Bruxelles, 1838.
Westwood, J. O. . Modern Classification of Insects.
" Obs. on Typhlopone. Ann. Mag. Nat. Hist, 1841.

ANTS, BEES, AND WASPS.

CHAPTER I.

INTRODUCTION.

THE Anthropoid apes no doubt approach nearer to man in bodily structure than do any other animals; but when we consider the habits of Ants, their social organisation, their large communities, and elaborate habitations; their roadways, their possession of domestic animals, and even, in some cases, of slaves, it must be admitted that they have a fair claim to rank next to man in the scale of intelligence. They present, moreover, not only a most interesting, but also a very extensive field of study.

Ants are divided into three families: the Formicidæ, Poneridæ, and Myrmicidæ, comprising many genera and a large number of species. In this country we have rather more than thirty kinds; but ants become more numerous in species, as well as individuals, in warmer countries, and more than a thousand species

are known. Even this large number is certainly far short of those actually in existence.[1]

I have kept in captivity about half of our British species of ants, as well as a considerable number of foreign forms, and for the last few years have generally had from thirty to forty communities under observation. After trying various plans, I found the most convenient method was to keep them in nests consisting of two plates of common window glass, about ten inches square, and at a distance apart of from $\frac{1}{10}$ to $\frac{1}{4}$ of an inch (in fact just sufficiently deep to allow the ants freedom of motion), with slips of wood round the edges, the intermediate space being filled up with fine earth. If the interval between the glass plates was too great, the ants were partly hidden by the earth, but when the distance between the plates of glass was properly regulated with reference to the size of the ants, they were open to close observation, and had no opportunity of concealing themselves. Ants, however, very much dislike light in their nests, probably because it makes them think themselves insecure, and I always therefore kept the nests covered over, except when under actual

[1] I have had some doubt whether I should append descriptions of the British species. On the whole, however, I have not thought it necessary to do so. They are well given in various entomological works: for instance, in Smith's *Cat. of British Fossorial Hymenoptera*, published by the Trustees of the British Museum; Saunders' 'Synopsis of British Heterogyna,' *Trans. Entomological Soc. London*; and in Mayr's *Die Europ. Formiciden*, all of which are cheap and easily procurable. I have, however, given figures of the principal species with which I have worked.

observation. I found it convenient to have one side of the nest formed by a loose slip of wood, and at one corner I left a small door. These glass nests I either kept in shallow boxes with loose glass covers resting on baize, which admitted enough air, and yet was impervious to the ants; or on stands surrounded either by water, or by fur with the hairs pointing downwards. Some of the nests I arranged on stands, as shown in

FIG. 1.

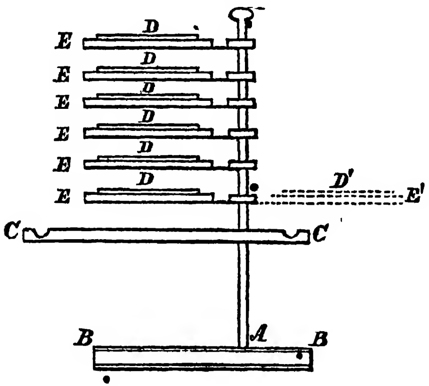


fig. 1. A A is an upright post fixed on a base B B. C C is a square platform of wood round which runs a ditch of water. Above are six nests, D, each lying on a platform E, which could be turned for facility of observation, as shown in the dotted lines D′ and E′. Thus the ants had a considerable range, as they could wander as far as the water ditch. The object of having the platform C C larger than the supports of the nests

was that if the ants fell, as often happened, they were within the water boundary, and were able to return home. This plan answered fairly well, and saved space, but it did not quite fulfil my hopes, as the ants were so pugnacious, that I was obliged to be very careful which nests were placed on the same stand.

Of course it is impossible to force the ants into these glass nests. On the other hand, when once the right way is known, it is easy to induce them to go in. When I wished to start a new nest I dug one up, and brought home the ants, earth, &c., all together. I then put them over one of my artificial nests, on one of the platforms surrounded by a moat of water. Gradually the outer earth dried up, while that between the two plates of glass, being protected from evaporation, retained its moisture. Under these circumstances the ants found it more suitable to their requirements, and gradually deserted the drier mould outside, which I removed by degrees. In the earth between the plates of glass the ants tunnelled out passages, chambers, &c. (fig. 2, p. 43), varying in form according to the circumstances and species.

Even between the plates of glass the earth gradually dried up, and I had to supply artificial rain from time to time. Occasionally also I gave them an altogether new nest. They seem, however, to get attached to their old homes, and I have still (August, 1882) one community which has inhabited the same glass case ever since 1874.

It is hardly necessary to say that the individual

ants belonging to the communities placed on the stands just described, knew their own nests perfectly well.

These nests gave me special facilities for observing the internal economy of ant life. Another main difference between my observations and those of previous naturalists has consisted in the careful record of the actions of individual ants. The most convenient mode of marking them was, I found, either with a small dab of paint on the back, or, in the case of bees or wasps, by snipping off a fragment at the extremity of the wing. This, I need hardly say, from the structure of the wing, gives the insect no pain; in fact, as it is only necessary to remove a minute portion, not sufficient to make any difference in their flight, they seemed scarcely to notice it. I never found any difficulty in painting bees or wasps; if they are given a little honey they become so intent that they quietly allow the paint to be applied. Of course too much must not be put on, and care must be taken not to touch the wings or cover up the spiracles. Ants require somewhat more delicate treatment, but with a little practice they could also be marked without any real difficulty.

No two species of Ants are identical in habits; and, on various accounts, their mode of life is far from easy to unravel. In the first place, most of their time is passed underground: all the education of the young, for instance, is carried on in the dark. Again, ants are essentially gregarious; it is in some cases difficult to

keep a few alive by themselves in captivity, and at any rate their habits under such circumstances are entirely altered. If, on the other hand, a whole community is kept, then the greater number introduces a fresh element of difficulty and complexity. Moreover, even individuals of the same species seem to differ in character, and the same individual will behave very differently under different circumstances. Although, then, ants have attracted the attention of many of the older naturalists,—Gould, De Geer, Reaumur, Swammerdam, Latreille, Leuwenhoeck, Huber,—and have recently been the object of interesting observations by Frederick Smith, Belt, Moggridge, Bates, Mayr, Emery, Forel, McCook, and others, they still present one of the most promising fields for observation and experiment.

The life of an ant falls into four well-marked periods—those of the egg, of the larva or grub, of the pupa or chrysalis, and of the perfect insect or imago. The eggs are white or yellowish, and somewhat elongated. They are hatched about fifteen days after being laid. Those observed by me have taken a month or six weeks.

The larvæ of ants (Pl. V. fig. 3), like those of bees and wasps, are small, white, legless grubs, somewhat conical in form, narrowing towards the head. They are carefully tended and fed, being carried about from chamber to chamber by the workers, probably in order to secure the most suitable amount of warmth

and moisture. I have observed, also, that they are very often assorted according to age. It is sometimes very curious in my nests to see them arranged in groups according to size, so that they remind one of a school divided into five or six classes.

As regards the length of life of the larvæ, Forel supposed[1] that those of *Tapinoma* matured the quickest, and were full-grown in about six or seven weeks. Some of *Myrmica ruginodis*, however, observed by me, turned into pupæ in less than a month. In other cases the period is much longer. In certain species, *Lasius flavus*, for instance, some of the larvæ live through the winter.

When full grown the larvæ turn into pupæ (Pl. V. fig. 4), sometimes naked, sometimes covered with a silken cocoon, constituting the so-called 'ant-eggs.' We do not yet understand why some larvæ spin cocoons, while others remain naked. As a general rule, the species which have not a sting, are enveloped in a cocoon, while those which have, are naked. Latrielle was the first to observe that in one species (*F. fusca*) the larvæ sometimes spin a cocoon, and sometimes remain naked. The reason for this difference is still quite unknown. After remaining some days in this state they emerge as perfect insects. In many cases, however, they would perish in the attempt, if they were not assisted; and it is very pretty to see the older ants helping them to extricate them-

[1] *Les Fourmis de la Suisse*, p. 420.

selves, carefully unfolding their legs and smoothing out the wings, with truly feminine tenderness and delicacy. Our countryman Gould long ago mentioned, and the fact has since been fully confirmed by Forel, that the pupæ are unable to emerge from the cocoons without the assistance of the workers. The ants generally remain from three to four weeks in this condition.

In the case of ants, as with other insects which pass through similar metamorphoses, such as bees, wasps, moths, butterflies, flies, and beetles, &c., the larval stage is the period of growth. During the chrysalis stage, though immense changes take place, and the organs of the perfect insect are more or less rapidly developed, no food is taken, and there is no addition to the size or weight.

The imago or perfect insect again takes food, but does not grow. The ant, like all the insects above named, is as large when it emerges from the pupa as it ever will be, though the abdomen of the females sometimes increases in size from the development of the eggs.

We have hitherto had very little information as to the length of life in ants in the imago, or perfect, state. So far, indeed, as the preparatory stages are concerned, there is little difficulty in approximately ascertaining the facts; namely, that while in summer they take only a few weeks, in some species, as our small yellow meadow ants (*Lasius flavus*), the autumn larvæ

remain with comparatively little change throughout the winter. It is much more difficult to ascertain the length of life of the perfect insect, on account of their gregarious habits, and the difficulty of recognising individual ants. I have found, however, as we shall presently see, that their life is much longer than has been generally supposed.

It is generally stated in entomological works that the males of ants die almost immediately. No doubt this is generally the case. At the same time, some males of *Myrmica ruginodis*, which I isolated with their mates in August 1876, lived until the following spring; one of them till May 17.

It has also been the general opinion that the females lived about a year. Christ[1] indeed thought they might last three or even four seasons, but this was merely a suggestion, and Forel expressed the general opinion when he said, 'Je suis persuadé qu'en automne il ne reste presque plus que les ouvrières écloses pendant le courant de l'été.' The average life of a queen is also, he thinks, not more than twelve months. I have found, however, that the life of the queens and workers is much longer than had been supposed. I shall give further details in a subsequent chapter, but I may just mention here that I have now (August 1882) two queens which have lived with me since the year 1874. They must therefore be at least eight years old, and seem still quite strong and

[1] *Naturgeschichte der Insekten.*

well. They continue still (1882) to lay a few eggs, which, I may add, produce workers.[1]

I have also some workers which I have had since 1875.

The body of an ant consists of three parts: the head, thorax, and abdomen. The head bears the principal organs of sense, and contains the brain, as the anterior portion of the nervous system may fairly be called. The thorax, supporting the legs and, when they are present, the wings, contains the principal muscles of locomotion. The abdomen contains the stomach and intestines, the organs of reproduction, the sting, &c.

Returning to the head: the antennæ consist of a short spherical basal piece, a long shaft, known as the scape, and a flagellum of from six to seventeen (generally, however, from ten to thirteen) short segments, the apical ones sometimes forming a sort of club. The number of segments is generally different in the males and females.

The eyes are of two kinds. Large compound eyes, one on each side of the head; and ocelli, or so-called simple eyes. The compound eyes consist of many facets. The number differs greatly in different species, and in the different sexes, the males generally having the greatest number. Thus, in *Formica pratensis* there are, according to Forel, in the males about 1,200 in each eye, in the fertile females between 800 and 900, in the workers about 600. Where the workers vary in size

[1] Having reference to the facts stated on page 87 this is a result of great physiological interest.

they differ also in the number of facets. Thus, again following the same authority, the large workers of *Camponotus ligniperdus* have 500, the smaller ones only 450; while in the Harvesting ant (*Atta barbara*) the contrast is even greater, the large specimens having 230, the small ones only from 80 to 90. The ordinary workers have in *Polyergus rufescens* about 400; in *Lasius fuliginosus*, 200; in *Tapinoma erraticum*, 100; in *Plagiolepis pygmæa*, 70 to 80; in *Lasius flavus*, about 80; in *Bothriomyrmex meridionalis*, 55; in *Strongylognathus testaceus*, *Stenamma Westwoodii*, and *Tetramorium cæspitum*, about 45; in *Pheidole pallidula*, about 30; *Myrmecina Latreillei*, 15; *Solenopsis fugax*, 6 to 9; while in *Ponera contracta* there are only from 1 to 5; in *Eciton* only 1; and in *Typhlopone* the eyes are altogether wanting.

The number of facets seems to increase rather with the size of the insect than with the power of vision.

The ocelli are never more than three in number, disposed in a triangle with the apex in front. Sometimes the anterior ocellus alone is present. In some species the workers are altogether without ocelli, which, however, are always present in the queens and in the males.

The mouth parts are the labrum, or upper lip; the first pair of jaws or mandibles; the second pair of jaws or maxillæ, which are provided with a pair of palpi, or feelers; and the lower lip, or labium, also bearing a pair of palpi.

The thorax is generally considered to consist, as in other insects, of three divisions—the prothorax, mesothorax, and metathorax. I have elsewhere, however, given reasons into which I will not at this moment enter, for considering that the first abdominal segment has in this group coalesced with the thorax. The thorax bears three pairs of legs, consisting of a coxa, trochanter, femur, tibia and tarsus, the latter composed of five segments and terminating in a pair of strong claws.

In the males and females the meso- and metathorax each bear a pair of wings, which, however, in the case of the female, are stripped off by the insects themselves soon after the marriage flight.

The workers never possess wings, nor do they show even a rudimentary representative of these organs. Dr. Dewitz has, however, pointed out that the full-grown larvæ of the workers possess well-developed 'imaginal disks,' like those which, in the males and females, develope into the wings. These disks, during the pupal life, gradually become atrophied, until in the perfect insects they are represented only by two strongly chitinised points lying under the large middle thoracic spiracles. No one unacquainted with the original history of these points would ever suspect them to be the rudimentary remnants of ancestral wings.[1]

The thorax also bears three pairs of spiracles, or breathing holes.

[1] *Zeit. f. wiss. Zool.*, vol. xxviii. p. 555.

The abdomen consists of six segments, in the queens and workers, that is to say in the females, and seven in the males. In the Formicidæ the first segment, as a general rule, forms a sort of peduncle (known as the scale or knot) between the metathorax and the remainder of the abdomen. In the Myrmicidæ two segments are thus detached from the rest.

The Poneridæ form, as regards the peduncle, and in some other respects, an intermediate group between the Formicidæ and the Myrmicidæ. The second abdominal segment is contracted posteriorly, but not so much so as to form a distinct knot.

The form of the knot offers in many cases valuable specific characters.

I am disposed to correlate the existence of a second knot among the Myrmicidæ with their power of stinging, which is wanting in the Formicidæ. Though the principal mobility of the abdomen is given in the former, as in the latter, by the joint between the metathorax and the knot, still the second segment of the peduncle must increase the flexibility, which would seem to be a special advantage to those species which have a sting. It must indeed be admitted that Œcophylla[1] has a sting, and yet only one knot; but this, of course, does not altogether negative my suggestion, which, however, I only throw out for consideration.

[1] *Proc. Linn. Soc.*, vol. v. p. 101.

The knot is provided with a pair of spiracles, which are situated, as Forel states, in the front of the segment, and not behind, as supposed by Latreille.

In most entomological works it is stated that the Myrmicidæ have a sting, and that, on the contrary, the Formicidæ do not possess one. The latter family, indeed, possess a rudimentary structure representing the sting, but it seems merely to serve as a support for the poison duct. Dr. Dewitz, who has recently published[1] an interesting memoir on the subject, denies that the sting in Formicidæ is a reduced organ, and considers it rather as in an undeveloped condition. The ancestors of our existing Ants, in his opinion, had a large poison apparatus, with a chitinous support like that now present in Formica, from which the formidable weapons of the bees, wasps, and Myrmicidæ have been gradually developed. I confess that I am rather disposed, on the contrary, to regard the condition of the organ in Formica as a case of retrogression contingent upon disuse. I find it difficult to suppose that organs—so complex, and yet so similar—as the stings of ants, bees, and wasps, should have been developed independently.

Any opinion expressed by M. Dewitz on such a subject is, of course, entitled to much weight; nevertheless there are some general considerations which seem to me conclusive against his view. If the sting

[1] *Zeit. f. wiss. Zool.*, vol. xxviii. p. 527.

of Formica represents a hitherto undeveloped organ, then the original ant was stingless, and the present stings of ants have an origin independent of that belonging to the other aculeate Hymenoptera, such as bees and wasps. These organs, however, are so complex, and at the same time so similarly constituted, that they must surely have a common origin. Whether the present sting is derived from a leaf-cutting instrument, such as that from which the sawfly takes its name, I will at present express no opinion. Dr. Dewitz himself regards the rudimentary traces of wings in the larvæ of ants as the remnants of once highly-developed organs; why, then, should he adopt the opposite view with reference to the rudimentary sting? On the whole, I must regard the ancestral ant as having possessed a sting, and consider that the rudimentary condition of that of Formica is due to atrophy, perhaps through disuse.

On the other hand, it is certainly, at first sight, difficult to understand why ants, having once acquired a sting, should allow it to fall into desuetude. There are, however, some considerations which may throw a certain light on the subject. The poison glands are much larger in Formica than in Myrmica. Moreover, some species have the power of ejecting their poison to a considerable distance. In Switzerland, after disturbing a nest of *Formica rufa*, or some nearly allied species, I have found that a hand held as much as 18 inches above the ants was covered with acid. But even when the poison

is not thus fired at the enemy from a distance, there are two cases in which the sting might be allowed to fall into disuse. Firstly, those species which fight with their mandibles might find it on the whole most convenient to inject the poison (as they do) into the wounds thus created. Secondly, if the poison itself is so intensified in virulence as to act through the skin, a piercing instrument would be of comparatively small advantage. I was amused one day by watching some specimens of the little *Cremastogaster sordidula* and the much larger *Formica cinerea*. The former were feeding on some drops of honey, which the Formicas were anxious to share, but the moment one approached, the little Cremastogasters simply threatened them with the tip of their abdomen, and the Formicas immediately beat a hasty retreat. In this case the comparatively large Formica could certainly have had nothing to fear from physical violence on the part of the little Cremastogaster. Mere contact with the poison, however, appeared to cause them considerable pain, and generally the threat alone was sufficient to cause a retreat.

However this may be, in their modes of fighting, different species of ants have their several peculiarities. Some also are much less military than others. *Myrmecina Latreillii*, for instance, never attack, and scarcely even defend themselves. Their skin is very hard, and they roll themselves into a ball, not defending themselves even if their nest is invaded; to pre-

vent which they make the entrances small, and often station at each a worker, who uses her head to stop the way. The smell of this species is also, perhaps, a protection. *Tetramorium cæspitum* has the habit of feigning death. This species, however, does not roll itself up, but merely applies its legs and antennæ closely to the body.

Formica rufa, the common Horse ant, attacks in serried masses, seldom sending out detachments, while single ants scarcely ever make individual attacks. They rarely pursue a flying foe, but give no quarter, killing as many enemies as possible, and never hesitating, with this object, to sacrifice themselves for the common good.

Formica sanguinea, on the contrary, at least in their slave-making expeditions, attempt rather to terrify than to kill. Indeed, when invading a nest, they do not attack the flying inhabitants unless these are attempting to carry off pupæ, in which case the *F. sanguineas* force them to abandon the pupæ. When fighting, they attempt to crush their enemies with their mandibles.

Formica exsecta is a delicate, but very active species. They also advance in serried masses, but in close quarters they bite right and left, dancing about to avoid being bitten themselves. When fighting with larger species they spring on to their backs, and then seize them by the neck or by an antenna. They also have the instinct of acting together, three

or four seizing an enemy at once, and then pulling different ways, so that she on her part cannot get at any one of her foes. One of them then jumps on her back and cuts, or rather saws, off her head. In battles between this ant and the much larger *F. pratensis*, many of the *F. exsectas* may be seen on the backs of the *F. pratensis*, sawing off their heads from behind.

The species of *Lasius* make up in numbers what they want in strength. Several of them seize an enemy at once, one by each of her legs or antennæ, and when they have once taken hold they will suffer themselves to be cut in pieces rather than leave go.

Polyergus rufescens, the celebrated slave-making or Amazon ant, has a mode of combat almost peculiar to herself. The jaws are very powerful, and pointed. If attacked—if, for instance, another ant seizes her by a leg—she at once takes her enemy's head into her jaws, which generally makes her quit her hold. If she does not, the *Polyergus* closes her mandibles, so that the points pierce the brain of her enemy, paralysing the nervous system. The victim falls in convulsions, setting free her terrible foe. In this manner a comparatively small force of *Polyergus* will fearlessly attack much larger armies of other species, and suffer themselves scarcely any loss.

Under ordinary circumstances an ants' nest, like a beehive, consists of three kinds of individuals: workers, or imperfect females (which constitute the

great majority), males, and perfect females. There are, however, often several queens in an ants' nest; while, as we all know, there is never more than one queen mother in a hive. The queens of ants are provided with wings, but after a single flight they tear them off, and do not again quit the nest. In addition to the ordinary workers there is in some species a second, or rather a third, form of female. In almost any ants' nest we may see that the workers differ more or less in size. The amount of difference, however, depends upon the species. In *Lasius niger*, the small brown garden ant, the workers are, for instance, much more uniform than in the little yellow meadow ant, or in *Atta barbara* (Pl. II. figs. 1 and 2), where some of them are much more than twice as large as others. But in certain ants there are differences still more remarkable. Thus, in a Mexican species, *Myrmecocystus*,[1] besides the common workers, which have the form of ordinary neuter ants, there are certain others in which the abdomen is swollen into an immense sub-diaphanous sphere. These individuals are very inactive, and serve principally as living honey-jars. I have described in a subsequent page a species of *Camponotus* (Pl. IV. fig. 1) from Australia, which presents us with the same remarkable phenomenon. In the genus *Pheidole* (Pl. II. figs. 3 and 4), very common in southern Europe, there are also two distinct forms without any intermediate gradations; one with heads of the usual propor-

[1] Wesmael, *Bull. Acad. Roy. Bruxelles*, vol. v. p. 771.

tion, and a second with immense heads provided with very large jaws. This differentiation of certain individuals so as to adapt them to special functions seems to me very remarkable; for it must be remembered that the difference is not one of age or sex. The large-headed individuals are generally supposed to act as soldiers, and the size of the head enables the muscles which move the jaws to be of unusual dimensions; but the little workers are also very pugnacious. Indeed, in some nests of *Pheidole megacephala*, which I had for some time under observation, the small workers were quite as ready to fight as the large ones.

Again, in the genus *Colobopsis* Emery discovered that two ants, then supposed to be different species, and known as *Colobopsis truncata* and *C. fuscipes*, are really only two forms of one species. In this case the entrance to the nest is guarded by the large-headed form, which may therefore fairly be called a soldier.

Savage observed among the Driver Ants, where also there are two kinds of workers, that the large ones arranged themselves on each side of the column formed by the small ones. They acted, he says, evidently the part of guides rather than of guards. At times they place 'their abdomen horizontally on the ground, and laying hold of fixed points with their hind feet (which together thus acted as a fulcrum), elevate the anterior portion of their bodies to the highest point, open wide their jaws, and stretch forth their antennæ, which for the most part were fixed, as if in the act of listening

and watching for approaching danger. They would occasionally drop their bodies to the ground again, run off to one side, and fiercely work their jaws and antennæ, as if having detected some strange sounds in the distance. Discerning nothing, they would quickly return to their posts and resume their positions, thus acting as scouts.'[1]

The same thing has been noticed by other naturalists. Bates, for instance, states that in the marching columns of *Eciton drepanophora* the large-headed workers 'all trotted along empty-handed and outside the column, at pretty regular intervals from each other, like subaltern officers in a marching regiment. . . I did not see them change their position, or take any notice of their small-headed comrades;' and he says that if the column was disturbed they appeared less pugnacious than the others.

In other species, however, of the same genus, *Eciton vastator* and *E. erratica*, which also have two distinct kinds of workers, the ones with large heads do appear to act mainly as soldiers. When a breach is made in one of their covered ways, the small workers set to work to repair the damage, while the large-headed ones issue forth in a menacing manner, rearing themselves up and threatening with their jaws.

In the Sauba Ant of South America (*Œcodoma cephalotes*), the complexity is carried still further;

[1] Rev. T. S. Savage on the 'Habits of the Driver Ants,' *Trans. Ent. Soc.*, vol. v. p. 12.

Lund[1] pointed out that there were two different kinds of workers, but Bates has since shown that there are in this species no less than five classes of individuals, namely: 1. Males. 2. Queens. 3. Small ordinary workers (Pl. III. fig. 2). 4. Large workers (Pl. III. fig. 1), with very large hairy heads. 5. Large workers, with large polished heads. Bates never saw either of these two last kinds do any work at all, and was not able to satisfy himself as to their functions. They have also been called soldiers, but this is obviously a misnomer—at least, they are said never to fight. Bates suggests[2] that they may 'serve, in some sort, as passive instruments of protection to the real workers. Their enormously large, hard, and indestructible heads may be of use in protecting them against the attacks of insectivorous animals. They would be, on this view, a kind of *pièces de resistance*, serving as a foil against onslaughts made on the main body of workers.'

This does not, I confess, appear to me a probable explanation of the fact, and on the whole it seems that the true function of these large-headed forms is not yet satisfactorily explained.

The question then arises whether these different kinds of workers are produced from different eggs.

I am disposed to concur with Westwood in the opinion[3] 'that the inhabitants of the nest have the instinct so to modify the circumstances producing this

[1] *Ann. des Sci. Nat.* 1831, p. 122. [2] *Loc. cit.*, p. 31.
[3] *Modern Classification of Insects*, vol. ii. p. 225.

state of imperfection, that some neuters shall exhibit characters at variance with those of the common kind.' This, indeed, credits them with a very remarkable instinct, and yet I see no more probable mode of accounting for the facts. Moreover, the exact mode by which the differences are produced is still entirely unknown.

M. Forel, in his excellent work on ants, has pointed out that very young ants devote themselves at first to the care of the larvæ and pupæ, and that they take no share in the defence of the nest or other out-of-door work until they are some days old. This seems natural, because at first their skin is comparatively soft; and it would clearly be undesirable for them to undertake rough work or run into danger until their armour had had time to harden. There are, however, reasons for thinking that the division of labour is carried still further. I do not allude merely to those cases in which there are completely different kinds of workers, but even to the ordinary workers. In *L. flavus*, for instance, it seems probable that the duties of the small workers are somewhat different from those of the large ones, though no such division of labour has yet been detected. I shall have to record some further observations pointing in the same direction.

The nests of ants may be divided into several classes. Some species, such as our common Horse ant (*Formica rufa*), collect large quantities of materials, such as bits of stick, fir leaves, &c., which they heap

up into conical masses. Some construct their nests of earth, the cells being partly above, partly below, the natural level. Some are entirely underground, others eat into the trunks of old trees.

In warmer climates the variations are still more numerous. *Formica bispinosa*, of Cayenne, forms its nest of the cottony matter from the capsules of Bombax. Sykes has described[1] a species of *Myrmica* which builds in trees and shrubs, the nest consisting of thin leaves of cow-dung, arranged like tiles on the roof of a house; the upper leaf, however, covering the whole.

In some cases the nests are very extensive. Bates mentions that while he was at Pará an attempt was made to destroy a nest of the Sauba ants by blowing into it the fumes of sulphur, and he saw the smoke issue from a great number of holes, some of them not less than seventy yards apart.

A community of ants must not be confused with an ant hill in the ordinary sense. Very often indeed a community has only one dwelling, and in most species seldom more than three or four. Some, however, form numerous colonies. M. Forel even found a case in which one nest of *F. exsecta* had no less than two hundred colonies, and occupied a circular space with a radius of nearly two hundred yards. Within this area they had exterminated all the other ants, except a few nests of *Tapinoma erraticum*, which survived, thanks to their great agility. In these cases the number of

[1] *Trans. Ent. Soc.*, vol. i.

ants thus associated together must have been enormous. Even in single nests Forel estimates the numbers at from five thousand to half a million.

Ants also make for themselves roads. These are not merely worn by the continued passage of the ants, as has been supposed, but are actually prepared by the ants, rather however by the removal of obstacles, than by any actual construction, which would indeed not be necessary, the weights to be carried being so small. In some cases these roadways are arched over with earth, so as to form covered ways. In others, the ants excavate regular subterranean tunnels, sometimes of considerable length. The Rev. Hamlet Clark even assures us that he observed one in South America, which passed under the river Parahyba at a place where it was as broad as the Thames at London Bridge. I confess, however, that I have my doubts as to this case, for I do not understand how the continuity of the tunnel was ascertained.

The food of ants consists of insects, great numbers of which they destroy; of honey, honeydew, and fruit: indeed, scarcely any animal or sweet substance comes amiss to them. Some species, such, for instance, as the small brown garden ant (*Lasius niger*, Pl. I. fig. 1), ascend bushes in search of aphides. The ant then taps the aphis gently with her antennæ, and the aphis emits a drop of sweet fluid, which the ant drinks. Sometimes the ants even build covered ways up to and over the aphides, which, moreover, they protect from the

attacks of other insects. Our English ants do not store up provision for the winter; indeed, their food is not of a nature which would admit of this. I have indeed observed that the small brown ant sometimes carries seeds of the violet into its nest, but for what purpose is not clear. Some of the southern ants, however, lay up stores of grain (*see* Chapter III.).

Ants have many enemies. They themselves, and still more their young, are a favourite food of many animals. They are attacked also by numerous parasites. If a nest of the brown ants is disturbed at any time during the summer, some small flies may probably be seen hovering over the nest, and every now and then making a dash at some particular ant. These flies belong to the genus *Phora*, and to a species hitherto unnamed, which Mr. Verrall has been good enough to describe for me (*see* Appendix). They lay their eggs on the ants, inside which the larvæ live. Other species of the genus are in the same way parasitic on bees. Ants are also sometimes attacked by mites. On one occasion I observed that one of my ants had a mite attached to the underside of its head. The mite, which maintained itself for more than three months in the same position, was almost as large as the head. The ant could not remove it herself. Being a queen, she did not come out of the nest, so that I could not do it for her, and none of her own companions thought of performing this kind office.

In character the different species of ants differ very

much from one another. *F. fusca* (Pl. I. fig. 3), the one which is pre-eminently the 'slave' ant, is, as might be expected, extremely timid; while the nearly allied *F. cinerea* has, on the contrary, a considerable amount of individual audacity. *F. rufa* (Pl. II. fig. 5), the horse ant, is, according to M. Forel, especially characterised by the want of individual initiative, and always moves in troops; he also regards the genus *Formica* as the most brilliant; though others excel it in other respects, as, for instance, in the sharpness of their senses. *F. pratensis* worries its slain enemies; *F. sanguinea* (Pl. I. fig. 6) never does so. The slave-making ant (*P. rufescens*, Pl. I. fig. 5) is, perhaps, the bravest of all. If a single individual finds herself surrounded by enemies, she never attempts to fly, as any other ant would, but transfixes her opponents one after another, springing right and left with great agility, till at length she succumbs, overpowered by numbers. *M. scabrinodis* is cowardly and thievish; during wars among the larger species they haunt the battle-fields and devour the dead. *Tetramorium* is said to be very greedy; *Myrmecina* very phlegmatic.

In industry ants are not surpassed even by bees and wasps. They work all day, and in warm weather, if need be, even at night too. I once watched an ant from six in the morning, and she worked without intermission till a quarter to ten at night. I had put her to a saucer containing larvæ, and in this time she

carried off no less than a hundred and eighty-seven to the nest. I kept another ant, which I employed in my experiments, under continuous observation several days. When I started for London in the morning, and again when I went to bed at night, I used to put her in a small bottle, but the moment she was let out she began to work again. On one occasion I was away from home for a week. On my return I took her out of the bottle, placing her on a little heap of larvæ about three feet from the nest. Under these circumstances I certainly did not expect her to return. However, though she had thus been six days in confinement, the brave little creature immediately picked up a larva, carried it off to the nest, and after half an hour's rest returned for another.

Our countryman Gould noticed[1] certain 'amusements' or 'sportive exercises,' which he had observed among ants. Huber also mentions[2] scenes which he had witnessed on the surface of ant hills, and which, he says, 'I dare not qualify with the title gymnastic, although they bear a close resemblance to scenes of that kind.' The ants raised themselves on their hind legs, caressed one another with their antennæ, engaged in mock combats, and almost seemed to be playing hide and seek. Forel entirely confirms Huber's statements, though he was at first incredulous. He says:[3]—

[1] *An Account of English Ants*, p. 103.
[2] *Nat. Hist. of Ants*, p. 197. [3] *Loc. cit.*, p. 367.

'Malgré l'exactitude avec laquelle il décrit ce fait, j'avais peine à y croire avant de l'avoir vu moi-même, mais une fourmilière pratensis m'en donna l'exemple à plusieurs reprises lorsque je l'approchai avec précaution. Des ☿ (*i.e.* workers) se saisissaient par les pattes ou par les mandibules, se roulaient par terre, puis se retachaient, s'entraînaient les unes les autres dans les trous de leur dôme pour en ressortir aussitôt après, etc. Tout cela sans aucun acharnement, sans venin ; il était évident que c'était purement amical. Le moindre souffle de ma part mettait aussitôt fin à ces jeux. J'avoue que ce fait peut paraître imaginaire à qui ne l'a pas vu, quand on pense que l'attrait des sexes ne peut en être cause.'

Bates, also, in the case of *Eciton legionis*, observed behaviour which looked to him 'like simple indulgence in idle amusement, the conclusion,' he says, 'that the ants were engaged merely in play was irresistible.'[1]

Lastly, I may observe that ants are very cleanly animals, and assist one another in this respect. I have often seen them licking one another. Those, moreover, which I painted for facility of recognition were gradually cleaned by their friends.

[1] *Loc. cit.*, vol. ii. p. 362.

CHAPTER II.

ON THE FORMATION AND MAINTENANCE OF NESTS, AND ON THE DIVISION OF LABOUR.

It is remarkable that notwithstanding the researches of so many excellent observers, and though ants' nests swarm in every field and every wood, we did not know how their nests commence.

Three principal modes have been suggested. After the marriage-flight the young queen may either—

1. Join her own or some other old nest;

2. Associate herself with a certain number of workers, and with their assistance commence a new nest; or

3. Found a new nest by herself.

The question can of course only be settled by observation, and the experiments made to determine it had hitherto been indecisive.

Blanchard, indeed, in his work on the 'Metamorphoses of Insects' (I quote from Dr. Duncan's translation, p. 205), says:—'Huber observed a solitary female go down into a small under-ground hole, take off her own wings, and become, as it were, a worker; then she constructed a small nest, laid a few eggs, and brought

up the larvæ by acting as mother and nurse at the same time.'

This, however, is not a correct version of what Huber says. His words are:—'I enclosed several females in a vessel full of light humid earth, with which they constructed lodges, where they resided, some singly, others in common. They laid their eggs and took great care of them; and notwithstanding the inconvenience of not being able to vary the temperature of their habitation, they reared some, which became larvæ of a tolerable size, but which soon perished from the effect of my own negligence.'[1]

It will be observed that it was the eggs, not the larvæ, which, according to Huber, these isolated females reared. It is true that he attributes the early and uniform death of the larvæ to his own negligence, but the fact remains that in none of his observations did an isolated female bring her offspring to maturity.

Other entomologists, especially Forel and Ebrard, have repeated the same observations with similar results; and as yet in no single case had an isolated female been known to bring her young to maturity. Forel even thought himself justified in concluding, from his observations and from those of Ebrard, that such a fact could not occur.

Lepeletier de St. Fargeau[2] was of opinion that ants' nests originate in the second mode indicated above, and

[1] *Natural History of Ants*, Huber, p. 121.
[2] *Hist. Nat. des Ins. Hyménoptères*, vol. i. p. 143.

it is, indeed, far from improbable that this may occur. No clear case has, however, yet been observed. M. de St. Fargeau himself observes[1] that 'les particularités qui accompagnent la formation première d'une fourmilière sont encore incertaines et mériteraient d'être observées avec soin.'

Under these circumstances I made the following experiments:—

1*a*. I took an old, fertile, queen from a nest of *Lasius flavus*, and put her to another nest of the same species. The workers became very excited and attacked her.

b. I repeated the experiment, with the same result.

c. Do. do. In this case the nest to which the queen was transferred was without a queen; still they would not receive her.

d and *e*. Do. do. do.

I conclude, then, that, at any rate in the case of *L. flavus*, the workers will not adopt an old queen from another nest.

The following observation shows that, at any rate in some cases, isolated queen ants are capable of giving origin to a new community.

On August 14, 1876, I isolated two pairs of *Myrmica ruginodis* which I found flying in my garden. I placed them with damp earth, food, and water, and they continued perfectly healthy through the winter.

[1] *Hist. Nat. des Ins. Hyménoptères*, vol. i. p. 114.

In April one of the males died, and the second in the middle of May. The first eggs were laid between April 12 and 23. They began to hatch the first week in June, and the first larva turned into a chrysalis on the 27th; a second on the 30th; a third on July 1, when there were also seven larvæ and two eggs. On the 8th there was another egg. On July 8 a fourth larva had turned into a pupa. On July 11 I found there were six eggs, and on the 14th about ten. On the 15th one of the pupæ began to turn brown, and the eggs were about 15 in number. On the 16th a second pupa began to turn brown. On the 21st a fifth larva had turned into a pupa, and there were about 20 eggs. On July 22 the first worker emerged, and a sixth larva had changed. On the 25th I observed the young worker carrying the larvæ about when I looked into the nest; a second worker was coming out. On July 28 a third worker emerged, and a fourth on Aug 5. The eggs appeared to be less numerous, and some had probably been devoured.

This experiment shows that the queens of *Myrmica ruginodis* have the instinct of bringing up larvæ and the power of founding communities. The workers remained about six weeks in the egg, a month in the state of larvæ, and twenty-five to twenty-seven days as pupæ.

Since, however, cases are on record in which communities are known to have existed for many years, it seems clear that fresh queens must be sometimes adopted. I have indeed recorded several experiments

in which fertile queens introduced into queenless nests were ruthlessly attacked, and subsequent experiments have always had the same result. Mr. Jenner Fust, however, suggested to me to introduce the queen into the nest, as is done with bees, in a wire cage, and leave her there for two or three days, so that the workers might, as it were, get accustomed to her. Accordingly I procured a queen of *F. fusca* and put her with some honey in a queenless nest, enclosed in a wire cage so that the ants could not get at her. After three days I let her out, but she was at once attacked. Perhaps I ought to have waited a few days longer. On the contrary, Mr. McCook reports a case of the adoption of a fertile queen of *Cremastogaster lineolata* by a colony of the same species:[1]—'The queen,' he says, 'was taken April 16, and on May 14 following was introduced to workers of a nest taken the same day. The queen was alone within an artificial glass formicary, and several workers were introduced. One of these soon found the queen, exhibited much excitement but no hostility, and immediately ran to her sister workers, all of whom were presently clustered upon the queen. As other workers were gradually introduced they joined their comrades, until the body of the queen (who is much larger than the workers) was nearly covered with them. They appeared to be holding on by their mandibles to the delicate hairs upon the female's body, and

[1] *Proc. Acad. Natural Sciences of Philadelphia*, 1879. 'Note on the Adoption of an Ant-Queen,' by Mr. McCook, p. 139.

continually moved their antennæ caressingly. This sort of attention continued until the queen, escorted by workers, disappeared in one of the galleries. She was entirely adopted, and thereafter was often seen moving freely, or attended by guards, about the nest, at times engaged in attending the larvæ and pupæ which had been introduced with the workers of the strange colony. The workers were fresh from their own natural home, and the queen had been in an artificial home for a month.'

In no case, however, when I have put a queen into one of my nests has she been accepted.

Possibly the reason for the difference may be that the ants on which I experimented had been long living in a republic; for, I am informed, that if bees have been long without a queen it is impossible to induce them to accept another.

Moreover, I have found that when I put a queen with a few ants from a strange nest they did not attack her, and by adding others gradually, I succeeded in securing the throne for her.

It is generally stated that among ants the queens only lay eggs. This, however, is not correct.

Denny[1] and Lespès[2] have shown that the workers also are capable of producing eggs; but the latter asserted that these eggs never come to maturity. Forel, however, has proved[3] that this is not the case, but

[1] *Ann. and Mag. Nat. Hist.*, 2nd ser., vol. i.
[2] *Ann. des Sci. Nat.*, 1863.
[3] *Fourmis de la Suisse*, p. 329

that in some cases, at any rate, the eggs do produce young. Dewitz even maintains[1] that the workers habitually lay eggs, and explains the difference which on this view exists between the workers of ants and those of bees, on the ground that (as he supposes) the majority of ants die in the autumn, so that the eggs laid by the queens alone would not be sufficient to stock the nest in the spring; while among bees the majority survive the winter, and consequently the eggs laid by the queen are sufficient to maintain the numbers of the community. In reply to this argument, it may be observed that among wasps the workers all perish in the autumn, while, on the contrary, among ants I have proved that, at least as regards many species, this is not the case. Moreover, although eggs are frequently laid by workers, this is not so often the case as Dewitz appears to suppose. Forel appears to have only observed it in one or two cases. In my nests the instances were more numerous; and, indeed, I should say that in most nests there were a few fertile workers.

Among bees and wasps also the workers are occasionally fertile; but, so far as our observations go, it is a curious fact that their eggs never produce females, either queens or workers, but always males. The four or five specimens bred by Forel from the eggs of workers were, moreover, all males.

It became therefore an interesting question whether

[1] *Zeit. f. wiss. Zool.*, vol. xxviii. p. 536.

the same is the rule among ants; and my nests have supplied me with some facts bearing on the question. Most of my nests contained queens; and in these it would be impossible, or at least very difficult, to distinguish and follow the comparatively few eggs laid by the workers. Some of my nests, however, contained no queen; and in them therefore all the eggs must have been laid by workers.

One of these was a nest of *Formica cinerea*, which I brought back from Castellamare in November 1875. At that time it contained no eggs or larvæ. In 1876 a few eggs were laid, of which fifteen came to maturity, and were, I believe, all males. In 1877 there were fourteen pupæ, of which twelve came to maturity, and were all males.

Again, in a nest of *Lasius niger*, kept in captivity since July 1875, there were in 1876 about 100 young; and these were, as far as I could ascertain, all males. At any rate there were about 100 males, and I could not find a single young female. In 1877 there were again some pupæ; but owing to an accident none of them came to maturity. In 1878 fifteen came to maturity; and fourteen were males. The other I could not find after it left the pupa skin; but I have no doubt, from the appearance of the pupa, that it was also a male.

Another nest of *Lasius niger*, taken in November 1875, brought in 1878 only one young ant to maturity; and this was a male.

Again, in a nest of *Formica fusca*, taken in 1875, though in 1876 and 1877 eggs were laid and a few arrived at the pupa-state, none came to maturity. They were all, however, either males or queens, and, I have little doubt, were males. In 1878 one came to maturity, and it was a male.

A nest of *F. fusca*, captured in 1876, did not bring up any young in 1877. In 1878 three larvæ came to maturity; and they all proved to be males. Another nest of *F. fusca*, captured in 1877, in 1878 brought only one young one to maturity. This was a male.

In the following year (1879), I again carefully watched my nests, to see what further light they would throw on the subject.

In six of those which contained no queen, eggs were produced, which of course must necessarily have been laid by workers.

The first of these, the nest of *Lasius niger*, which I have watched since July 1875, and which, therefore, is interesting from the great age of the workers, about ten larvæ were hatched, but only four reached the pupa state. Of these one disappeared; the other three I secured, and on examination they all proved to be males. The nest of *Lasius niger*, which has been under observation since November 1875, produced about ten pupæ. Of these I examined seven, all of which I found to be males. The others escaped me. I believe that, having died, they were brought out and thrown away.

The nest of *Formica cinerea*, captured at the same time, produced four larvæ, all of which perished before arriving at the pupa stage. The larvæ of males and of queens are much larger than those of workers, and these larvæ were too big to have been those of workers.

In a nest of *Formica fusca*, which I have had under observation since August 1876, three pupæ were produced. They were all males. Another nest of *Formica fusca* produced a single young one, which also was a male.

Lastly, my nest of *Polyergus rufescens*, which M. Forel was so good as to send me in the spring of 1876, in 1879 produced twelve pupæ. Eleven of these turned out to be males. The other one I lost; and I have little doubt that it was brought out and thrown away. It was certainly not a worker. As regards the first three of these pupæ, I omitted to record at the time whether they belonged to the *Polyergus* or to the slaves, though I have little doubt that they belonged to the former species. The last eight, at any rate, were males of *Polyergus*.

Indeed, in all of my queenless nests, males have been produced; and in not a single queenless nest has a worker laid eggs which have produced a female, either a queen or a worker. Perhaps I ought to add that workers are abundantly produced in those of my nests which possess a queen.

While great numbers of workers and males have

come to maturity in my nests, with one exception not a single queen has been produced.

This was in a nest of *Formica fusca*, in which five queens came to maturity. The nest (which, I need hardly say, possessed a queen) had been under observation since April 1879, and the eggs therefore must have been laid in captivity. The nest had been richly supplied with animal food, which may possibly account for the fact.

It is known that bees, by difference of food, &c., possess the power of obtaining at will from the same eggs either queens or ordinary workers. Mr. Dewitz,[1] however, is of opinion that among ants, on the contrary, the queens and workers are produced from different kinds of eggs. He remarks that it is very difficult to understand how the instinct, if it is to be called instinct, which would enable the working ants to make this difference can have arisen. This is no doubt true; but it seems to me quite as difficult to understand how the queens, which must have originally laid only queen eggs and male eggs, can have come to produce another class. Moreover, however great the difficulty may be to understand how the ants can have learnt to produce queens and workers from one kind of egg, the same difficulty exists almost to the same extent in bees, which, as Mr. Dewitz admits, do possess the power. Moreover, it seems to me very unlikely that the result is produced in one way in the case of

[1] *Zeit. für wiss. Zool.* 1878, p. 101.

bees, and in another in that of ants. It is also a strong argument that in none of my nests, though thousands of workers and males have been produced, had I ever observed a queen to be so until the year 1879. On the whole, then, though I differ from so excellent a naturalist with much hesitation, I cannot but think that ants, like bees, possess the power of developing a given egg into either a queen or a worker.

I have already mentioned that the previous views as to the duration of life of ants turn out to be quite erroneous. It was the general opinion that they lived for a single year. I have, however, now in my possession two queens, which I have had under observation ever since the year 1874. They must now (October, 1884) therefore be more than ten years old. They seem in perfect health, and every year have laid eggs producing workers, a fact which suggests physiological conclusions of great interest.

I have, moreover, little doubt that some of the workers now in this nest were among those originally captured, the mortality after the first few weeks having been but small. This, however, I cannot prove.

A nest of *F. sanguinea*, which M. Forel kindly forwarded to me on September 12, 1875 (but which contained no queen), gradually diminished in numbers, until in February 1879 it was reduced to two *F. sanguineas* and one slave. The latter died in February 1880. One of the two mistresses died between May 10 and May 16, 1880, and the other only survived her

a few days, dying between the 16th and 20th. These two ants, therefore, must have been five years old at least. It is certainly curious that they should, after living so long, have died within ten days of one another. There was nothing, as far as I could see, in the state of the nest or the weather to account for this, and they were well supplied with food; yet I hardly venture to suggest that the survivor pined away for the loss of her companion.

Some workers of *F. cinerea* lived in one of my nests from November 1875 to April 1882.

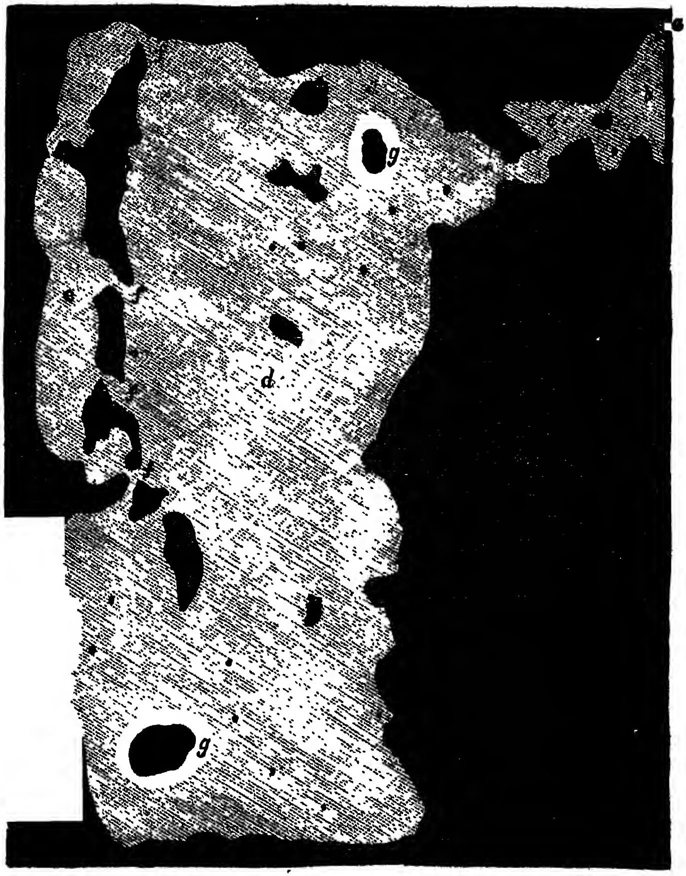
Workers of *F. fusca* have attained the age of six years in several of my nests, and in one of *Lasius niger* brought in on November 30, 1875, there were no queens; and, as already mentioned, no workers have been produced. Those now living (February 1883) are therefore the original ones, and they must be more than seven years old.

The duration of life in ants is therefore much greater than has been hitherto supposed.

Though I lose many ants from accidents, especially in summer, in winter there are very few deaths.

I have given the following figure (fig. 2), which represents a typical nest belonging to *Lasius niger*, because it is a good instance of the mode in which my ants excavated chambers and galleries for themselves, and seems to show some ideas of strategy. The nest is, as usual, between two plates of glass, the outer border is a framework of wood, and the shaded part

FIG. 2.



Ground-plan of a typical nest of *Lasius niger*, reduced. *a*, narrow doorway; *b*, hall; *c*, vestibule; *d*, main chamber; *e*, inner sanctum; *f, f, f, f*, narrow entrance passages to sanctum; *g, g*, special pillars

represents garden mould, which the ants have themselves excavated, as shown in the figure. For the small doorway (*a*), indeed, I am myself responsible. I generally made the doorways of my nests narrow, so as to check evaporation and keep the nests from becoming too dry. It will be observed, however, that behind the hall (*b*) the entrance contracts, and is still further protected by a pillar of earth, which leaves on either side a narrow passage which a single ant could easily guard, or which might be quickly blocked up. Behind this is an irregular vestibule (*c*), contracted again behind into a narrow passage, which is followed by another, this latter opening into the main chamber (*d*). In this chamber several pillars of earth are left, almost as if to support the roof. Behind the main chamber is an inner sanctum divided into three chambers, and to which access is obtained through narrow entrances (*f*, *f*, *f*, *f*). Most of the pillars in the main chamber are irregular in outline, but two of them (*g*, *g*) were regular ovals, and round each, for a distance about as long as the body of an ant, the glass had been most carefully cleaned. This was so marked, and the edge of the cleaned portion was so distinct, that it is impossible not to suppose that the ants must have had some object in this proceeding, though I am unable to suggest any explanation of it.

I have already mentioned (*ante*, p. 23), that there is evidence of some division of labour among ants. Where, indeed, there are different kinds of workers,

this is self-evident, but even in species where the workers are all of one type, something of the same kind appears to occur.

In the autumn of 1875 I noticed an ant belonging to one of my nests of *F. fusca* out feeding alone. The next day the same ant was again out by herself, and for some weeks no other ant, so far as I observed, came out to the food. I did not, however, watch her with sufficient regularity. In the winter of 1876, therefore, I kept two nests under close observation, having arranged with my daughters and their governess, Miss Wendland (most conscientious observers), that one of us should look at them once an hour during the day. One of the nests contained about 200 individuals of *F. fusca*, the other was a nest of *P. rufescens* with the usual slaves, about 400 in number. The mistresses themselves never came out for food, leaving all this to the slaves.

We began watching on November 1, but did not keep an hourly register till the 20th, after which date the results are given in the following tables (*see* Appendix). Table No. 1 relates to the nest of *F. fusca*, and the ants are denoted by numbers. The hours at which we omitted to record an observation are left blank; when no ant was at the honey, the square is marked with an 0. An ant, marked in my register as No. 3, was at the time when we began observing acting as feeder to the community.

The only cases in which other ants came to the honey were at 2 P.M. on November 22, when another ant came

out, whom we registered as No. 4, another on the 28th, registered as No. 5. Other ants came out occasionally, but not one came to the honey (except the above mentioned) from November 28 till January 3, when another (whom we registered as No. 6) began feeding. After this a friend visited the honey once on the 4th, once on the 11th, and again on the 15th, when she was registered as No. 7.

Table No. 2 is constructed in the same way, but refers to the nest of *Polyergus*. The feeders in this case were, at the beginning of the experiment, registered as Nos. 5, 6, and 7. On November 22 a friend, registered as No. 8, came to the honey, and again on December 11; but with these two exceptions the whole of the supplies were carried in by Nos. 5 and 6, with a little help from No. 7.

Thinking now it might be alleged that possibly these were merely unusually active or greedy individuals, I imprisoned No. 6 when she came out to feed on the 5th. As will be seen from the table, no other ant had been out to the honey for some days; and it could therefore hardly be accidental that on that very evening another ant (then registered as No. 9) came out for food. This ant, as will be seen from the table, then took the place of No. 6, and (No. 5 being imprisoned on January 11) took in all the supplies, again with a little help from No. 7. So matters continued till the 17th, when I imprisoned No. 9; and then again, *i.e.* on the 19th, another ant (No. 10) came out for the food,

aided, on and after the 22nd, by another, No. 11. This seems to me very curious. From November 1 to January 5, with two or three casual exceptions, the whole of the supplies were carried in by three ants, one of whom, however, did comparatively little. The other two were imprisoned, and then, but not till then, a fresh ant appears on the scene. She carried in the food for a week; and then, she being imprisoned, two others undertook the task. On the other hand, in Nest 1, where the first foragers were not imprisoned, they continued during the whole time to carry in the necessary supplies.

The facts therefore certainly seem to indicate that certain ants are told off as foragers, and that during winter, when little food is required, two or three are sufficient to provide it.

I have, indeed, no reason to suppose that in our English ants any particular individuals are specially adapted to serve as receptacles of food. M. Wesmael, however, has described[1] a remarkable genus (*Myrmecocystus mexicanus*), brought by M. de Normann from Mexico, in which certain individuals in each nest serve as animated honey-pots. To them the foragers bring their supplies, and their whole duty seems to be to receive the honey, retain it, and redistribute it when required. Their abdomen becomes enormously distended, the intersegmental membranes being so much extended that

[1] *Bull de l'Acad des Sci. de Bruxelles*, vol. v. p. 771.

the chitinous segments which alone are visible externally in ordinary ants seem like small brown transverse bars. The account of these most curious insects given by MM. de Normann and Wesmael has been fully confirmed by subsequent observers; as, for instance, by Lucas,[1] Saunders,[2] Edwards,[3] Blake,[4] Loew,[5] and McCook.[6]

On one very important point, however, M. Wesmael was in error; he states that the abdomen of these abnormal individuals 'ne contient aucun organe; ou plutôt, il n'est lui-même qu'un vaste sac stomacal.' Blake even asserts that 'the intestine of the insect is not continued beyond the thorax,' which must surely be a misprint; and also that there is no connexion between the stomach and the intestine! These statements, however, are entirely erroneous; and, as M. Forel has shown, the abdomen does really contain the usual organs, which, however, are very easily overlooked by the side of the gigantic crop.

I have therefore been much interested in receiving a second species of ant, which has been sent me by Mr. Waller, in which a similar habit has been evolved and a similar modification has been produced. The two species, however, are very distinct, belonging to totally

[1] *Ann. Soc. Ent. de France*, v. p. 111.
[2] *Canadian Entomologist*, vol. vii. p. 12.
[3] *Proc. California Academy*, 1873.
[4] *Ibid.*, 1874.
[5] *American Nat.*, viii. 1874.
[6] *The Honey Ants.*

different genera; and the former is a native of Mexico, while the one now described comes from Adelaide in Australia. The two species, therefore, cannot be descended one from the other; and the conclusion seems inevitable that the modification has originated independently in the two species.[1]

It is interesting that, although these specimens apparently never leave the nest, and have little use therefore for legs, mandibles, &c., the modifications which they have undergone seem almost confined to the abdominal portion of the digestive organs. The head and thorax, antennæ, jaws, legs, &c. differ but little from those of ordinary ants.

[1] I have since received another species from Australia with the same peculiarity.

CHAPTER III.

ON THE RELATION OF ANTS TO PLANTS.

It is now generally admitted that the form and colour, the scent and honey of flowers, are mainly due to the unconscious agency of insects, and especially of bees. Ants have not exercised so great an influence over the vegetable kingdom, nevertheless they have by no means been without effect.

The great object of the beauty, scent, and honey of flowers, is to secure cross fertilisation; but for this purpose winged insects are almost necessary, because they fly readily from one plant to another, and generally confine themselves for a certain time to the same species. Creeping insects, on the other hand, naturally would pass from one flower to another on the same plant; and as Mr. Darwin has shown, it is desirable that the pollen should be brought from a different plant altogether. Moreover, when ants quit a plant, they naturally creep up another close by, without any regard to species. Hence, even to small flowers, such as many crucifers, composites, saxifrages, &c., which, as far as size is concerned, might well be fertilised by ants, the visits of flying insects are much more advan-

tageous. Moreover, if larger flowers were visited by ants, not only would they deprive the flowers of their honey without fulfilling any useful function in return, but they would probably prevent the really useful visits of bees. If you touch an ant with a needle or a bristle, she is almost sure to seize it in her jaws; and if bees, when visiting any particular plant, were liable to have the delicate tip of their proboscis seized on by the horny jaws of an ant, we may be sure that such a species of plant would soon cease to be visited. On the other hand, we know how fond ants are of honey, and how zealously and unremittingly they search for food. How is it then that they do not anticipate the bees, and secure the honey for themselves? This is guarded against in several ways.

Belt appears to have been the first naturalist to call attention to this interesting subject.

'Many flowers,' he says,[1] 'have contrivances for preventing useless insects from obtaining access to the nectaries.

. . . .

'Great attention has of late years been paid by naturalists to the wonderful contrivances amongst flowers to secure cross fertilisation, but the structure of many cannot, I believe, be understood, unless we take into consideration not only the beautiful adaptations for securing the services of the proper insect or

[1] *The Naturalist in Nicaragua.* By Thos. Belt, F.G.S., pp. 131 and 133.

bird, but also the contrivances for preventing insects that would not be useful from obtaining access to the nectar. Thus the immense length of the *Angræcum sesquipedale* of Madagascar might, perhaps, have been more easily explained by Mr. Wallace, if this important purpose had been taken into account.'

Kerner has since published a very interesting work,[1] especially devoted to the subject, which has been translated into English by Dr. Ogle.

In aquatic plants, of course, the access of ants is precluded by the isolation in water. Nay, even many land plants have secured to themselves the same advantage, the leaves forming a cup round the stem. Some species have such a leaf-cup at each joint, in others there is only a single basin, formed by the rosette of radical leaves. In these receptacles rain and dew not only collect, but are retained for a considerable time. In our own country *Dipsacus sylvestris* (the common teazle) is the best marked instance of this mode of protection, though it is possible that these cups serve another purpose, and form, as suggested by Francis Darwin, traps in which insects are caught, and in which they are dissolved by the contained fluid, so as to serve as food for the plant. However this may be, the basins are generally found to contain water, even if no rain has fallen for some days, and must, therefore, serve to prevent the access of ants.

The next mode of protection is by means of slippery

[1] Kerner: *Flowers and their Unbidden Guests.*

surfaces. In this case, also, the leaves often form a collar round the stem, with curved surfaces over which ants cannot climb. 'I have assured myself,' says Kerner, 'not only by observation, but by experiment, that wingless insects, and notably ants, find it impossible to mount upwards over such leaves as these. The little creatures run up the stem, and may even not unfrequently traverse the under surface of the leaves, if not too smooth; but the reflexed and slippery margin is more than the best climbers among them can get over, and if they attempt it they invariably fall to the ground. There is no necessity for the lamina of the leaf to be very broad; even narrow leaves, as, for instance, those of *Gentiana verna*, are enough for the purpose, supposing, of course, that the margin is bent backwards in the way described.'

Of this mode of protection the cyclamen and snowdrop offer familiar examples. In vain do ants attempt to obtain access to such flowers, the curved surfaces baffle them; when they come to the edge they inevitably drop off to the ground again. In fact, these pendulous flowers protect the honey as effectually from the access of ants, as the hanging nests of the weaver and other birds protect their eggs and young from the attacks of reptiles.

In a third series of plants the access of creeping insects is impeded or altogether prevented by certain parts of the flower being crowded together so as to leave either a very narrow passage or none at all. Thus

the *Antirrhinum*, or snapdragon, is completely closed, and only a somewhat powerful insect can force its way in. The flower is in fact a strong box, of which the Humble-bee only has the key. The Linarias are another case of this kind. The Campanulas, again, are open flowers, but the stamens are swollen at the base, and in close contact with one another, so that they form the lid of a hollow box in which the honey is secreted. In some species the same object is effected by the stamens being crowded together, as in some of the white Ranunculuses of the Alps. In other cases, the flower forms a narrow tube, still further protected by the presence of hairs, sometimes scattered, sometimes, as in the white dead nettle, forming a row.

In others, as in some species of Narcissus, Primula, Pedicularis, &c., the tube itself is so narrow that even an ant could not force its way down.

In others, again, as in some of the Gentians, the opening of the tube is protected by the swollen head of the pistil.

In others, as in clover, lotus, and many other *Leguminosæ*, the ovary and the stamens, which cling round the ovary in a closely-fitting tube, fill up almost the whole space between the petals, leaving only a very narrow tube.

Lastly, in some, as in *Geranium robertianum*, *Linum catharticum*, &c., the main tube itself is divided by ridges into several secondary ones.

In still more numerous species the access of ants and other creeping insects is prevented by the presence of spines or hairs, which constitute a veritable *chevaux de frise.* Often these hairs are placed on the flowers themselves, as in some verbenas and gentians. Sometimes the whole plant is more or less hairy, and it will be observed that the hairs of plants have a great tendency to point downwards, which of course constitutes them a more efficacious barrier.

In another class of cases access to the flowers is prevented by viscid secretions. Everyone who has any acquaintance with botany knows how many species bear the specific name of 'Viscosa' or 'Glutinosa.' We have, for instance, *Bartsia viscosa*, *Robinia viscosa*, *Linum viscosum*, *Euphrasia viscosa*, *Silene viscosa*, *Dianthus viscidus*, *Senecio viscosus*, *Holosteum glutinosum*, &c. Even those who have never opened a botanical work must have noticed how many plants are more or less sticky. Why is this? What do the plants gain by this peculiarity? The answer probably is, at any rate in most cases, that creeping insects are thus kept from the flowers. The viscid substance is found most frequently and abundantly on the peduncles immediately below the blossoms, or even on the blossoms themselves. In *Epimedium alpinum*, for instance, the leaves and lower parts of the stem are smooth, while the peduncles are covered with glandular, viscid hairs. The number of small insects which are limed and perish on such plants is very considerable. Kerner

counted sixty-four small insects on one inflorescence of *Lychnis viscosa.* In other species the flower is viscid; as, for instance, in the gooseberry, *Linnœa borealis*, *Plumbago Europœa*, &c.

Polygonum amphibium is a very interesting case. The small rosy flowers are richly supplied with honey; but from the structure of the flower, it would not be fertilised by creeping insects. As its name indicates, this plant grows sometimes on land, sometimes in water. Those individuals, however, which grow on dry land are covered by innumerable glandular viscid hairs, which constitute an effectual protection. On the other hand, the individuals which grow in water are protected by their situation. To them the glandular hairs would be useless, and in fact on such specimens they are not developed.

In most of the cases hitherto mentioned the viscid substance is secreted by glandular hairs, but in others it is discharged by the ordinary cells of the surface. Kerner is even of opinion that the milky juice of certain plants—for instance, of some species of *Lactuca* (lettuce)—answers the same purpose. He placed several kinds of ants on these plants, and was surprised to find that their sharp claws cut through the delicate epidermis; while through the minute clefts thus made the milky juice quickly exuded, by which the ants were soon glued down. Kerner is even disposed to suggest that the nectaries which occur on certain leaves are a means of protection against the unwel-

come, because unprofitable, visits of creeping insects, by diverting them from the flowers.

Thus, then, though ants have not influenced the present condition of the vegetable kingdom to the same extent as bees, yet they also have had a very considerable effect upon it in many ways.

Our European ants do not strip plants of their leaves. In the tropics, on the contrary, some species do much damage in this manner.

Bates considers[1] that the leaves are used 'to thatch the domes which cover the entrances to their subterranean dwellings, thereby protecting them from the rains.' Belt, on the other hand, maintains that they are torn up into minute fragments, so as to form a flocculent mass, which serves as a bed for mushrooms; the ants are, in fact, he says, 'mushroom growers and eaters.'[2]

Some trees are protected by one species of ants from others. A species of Acacia, described by Belt, bears hollow thorns, while each leaflet produces honey in a crater-formed gland at the base, as well as a small, sweet, pear-shaped body at the tip. In consequence, it is inhabited by myriads of a small ant, which nests in the hollow thorns, and thus finds meat, drink, and lodging all provided for it. These ants are continually roaming over the plant; and constitute a most efficient body-guard, not only driving off the leaf-cutting ants, but, in Belt's opinion, rendering the leaves less liable to be

[1] *Loc. cit.*, v. i. p. 26. [2] *Loc. cit.*, p. 79.

eaten by herbivorous mammalia. Delpino mentions that on one occasion he was gathering a flower of *Clerodendrum fragrans*, when he was himself 'suddenly attacked by a whole army of small ants.'[1]

Moseley has also called attention[2] to the relations which have grown up between ants and two 'curious epiphytes, *Myrmecodia armata* and *Hydnophytum formicarum*. Both plants are associated in their growth with certain species of ants. As soon as the young plants develop a stem, the ants gnaw at the base of this, and the irritation produced causes the stem to swell; the ants continuing to irritate and excavate the swelling, it assumes a globular form, and may become even larger than a man's head.

'The globular mass contains within a labyrinth of chambers and passages, which are occupied by the ants as their nest. The walls of these chambers and the whole mass of the inflated stem retain their vitality and thrive, continuing to increase in size with growth. From the surface of the rounded mass are given off small twigs, bearing the leaves and flowers.

'It appears that this curious gall-like tumour on the stem has become a normal condition of the plants, which cannot thrive without the ants. In *Myrmecodia armata* the globular mass is covered with spine-like excrescences. The trees I referred to at Amboina had these curious spine-covered masses perched in every

[1] *Scientific Lectures*, p. 33.
[2] *Notes by a Naturalist on the 'Challenger,'* p. 389.

fork, and with them also smooth surfaced masses of a species of *Hydnophytum*.'

There are, of course, many cases in which the action of ants is very beneficial to plants. They kill off a great number of small caterpillars and other insects. Forel found in one large nest that more than twenty-eight dead insects were brought in per minute; which would give during the period of greatest energy more than 100,000 insects destroyed in a day by the inhabitants of one nest alone.

Our English hunting ants generally forage alone, but in warmer countries they hunt in packs, or even troops.

As already mentioned, none of our northern ants store up grain, and hence there has been much discussion as to the well-known passage of Solomon. I have indeed observed that the small brown ants, *Lasius niger*, sometimes carry seeds of the violet into their nests, but for what purpose is not clear. It is, however, now a well-established fact that more than one species of southern ants do collect seeds of various kinds. The fact, of course, has long been known in those regions.

Indeed, the quantity of grain thus stored up is sometimes so considerable, that in the 'Mischna,' rules are laid down with reference to it; and various commentators, including the celebrated Maimonides, have discussed at length the question whether such grain belonged to the owner of the land, or might be taken

by gleaners—giving the latter the benefit of the doubt. They do not appear to have considered the rights of the ants.

Hope[1] has called attention to the fact that Meer Hassan Ali, in his 'History of the Mussulmans,' expressly mentions it. 'More industrious little creatures,' he says, 'cannot exist than the small red ants, which are so abundant in India. I have watched them at their labours for hours, without tiring. They are so small, that from eight to twelve in number labour with great difficulty to convey a grain of wheat or barley, yet these are not more than half the size of a grain of English wheat. I have known them to carry one of these grains to their nest, at a distance from 600 to 1,000 yards. They travel in two distinct lines over rough or smooth ground, as it may happen, even up and down steps, at one regular pace. The returning unladen ants invariably salute the burthened ones, who are making their way to the general storehouse; but it is done so promptly, that the line is neither broken nor their progress impeded by the salutation.'

Sykes, in his account of an Indian ant, *Pheidole providens*,[2] appears to have been the first of modern scientific authors to confirm the statements of Solomon. He states that the above-named species collects large stores of grass seeds, on which it subsists from February

[1] *Trans. Ent. Soc.* 1840, p. 213.

[2] *Ibid.* 1836, p. 99. Dr. Lincecum has also made a similar observation.

to October. On one occasion he even observed the ants bringing up their stores of grain to dry them after the closing thunderstorms of the monsoon; an observation which has been since confirmed by other naturalists.

It is now known that harvesting ants occur in the warmer part of Europe, where their habits have been observed with care, especially by Moggridge and Lespès. It does not yet seem quite clear in what manner the ants prevent the grains from germinating. Moggridge found that if the ants were prevented from entering the granaries, the seeds began to sprout, and that this was also the case in deserted granaries. It would appear therefore that the power of germination was not destroyed.

On the other hand, Lespès confirms the statement long ago made by Aldrovandus that the ants gnaw off the radicle, while Forel asserts that *Atta structor* allows the seeds in its granaries to commence the process of germination for the sake of the sugar.

A Texan ant, *Pogonomyrmex barbatus*, is also a harvesting species, storing up especially the grains of *Aristida oligantha*, the so-called 'ant rice,' and of a grass, *Buchlœ dactyloides*. These ants clear disks, ten or twelve feet in diameter, round the entrance to their nest, a work of no small labour in the rich soil, and under the hot sun, of Texas. I say 'clear disks,' but some, though not all, of these disks are occupied, especially round the edge, by a growth of ant rice. These

ants were first noticed by Mr. Buckley,[1] and their habits were some time afterwards described in more detail by Dr. Lincecum,[2] who maintained not only that the ground was carefully cleared of all other species of plants, but that this grass was intentionally cultivated by the ants. Mr. McCook,[3] by whom this subject has been recently studied, fully confirms Dr. Lincecum that the disks are kept carefully clean, that the ant rice alone is permitted to grow on them, and that the produce of this crop is carefully harvested; but he thinks that the ant rice sows itself, and is not actually cultivated by the ants. I have myself observed in Algeria, that certain species of plants are allowed by the ants to grow on their nests.

[1] *Proc. Acad. Nat. Sci. Philadelphia*, 1860.
[2] *Linnean Journal*, 1861, p. 29.
[3] *The Nat. Hist. of the Agricultural Ants of Texas*, p. 38.

CHAPTER IV.

ON THE RELATIONS OF ANTS TO OTHER ANIMALS.

THE relations existing between ants and other animals are even more interesting than their relations with plants. As a general rule, not, however, without many remarkable exceptions, they may be said to be those of deadly hostility.

Though honey is the principal food of my ants, they are very fond of meat, and in their wild state ants destroy large numbers of other insects. Our English ants generally go out hunting alone, but many of the species living in hotter climates hunt in packs, or even in troops.

Savage has given[1] a graphic account of the 'Driver' ants (*Anomma arcens, West.*) of West Africa. They keep down, he says, 'the more rapid increase of noxious insects and smaller reptiles; consume much dead animal matter, which is constantly occurring, decaying, becoming offensive, and thus vitiating the atmosphere, and which is by no means the least important in the Torrid Zone, often compelling the inhabitants to keep

[1] 'On the Habits of the Driver Ants,' *Trans. Ent. Soc.* 1847 p. 14.

their dwellings, towns, and their vicinity in a state of comparative cleanliness. The dread of them is upon every living thing. . . . .

'Their entrance into a house is soon known by the simultaneous and universal movement of rats, mice, lizards, Blapsidæ, Blàttidæ, and of the numerous vermin that infest our dwellings. Not being agreed, they cannot dwell together, which modifies in a good measure the severity of the Drivers' habits, and renders their visits sometimes (though very seldom in my view) desirable. . . . .

'They move over the house with a good degree of order, unless disturbed, occasionally spreading abroad, ransacking one point after another, till, either having found something desirable, they collect upon it, when they may be destroyed *en masse* by hot water. . . . .

'When they are fairly in, we give up the house, and try to await with patience their pleasure, thankful, indeed, if permitted to remain within the narrow limits of our beds or chairs.'

These ants will soon destroy even the largest animal if it is confined. In one case Savage saw them kill near his house a snake four feet long. Indeed, it is said that they have been known to destroy the great python, when gorged with food and powerless. The natives even believe that the python, after crushing its victim, does not venture to swallow it, until it has made a search, and is satisfied that there are no Drivers in the vicinity! It is very remarkable that these hunting

inclination to crime shows itself in its greatest intensity towards the age of 23 or 24, and goes on from thence gradually diminishing up to extreme old age, contrary to what happens to the suicidal tendency. We might produce confirmation of this antagonism from the statistics of Italian convicts, of whom 45·7 per cent. are between 20 and 30 years of age, and from those of England and Austria, of whom only 42·5 per cent. are of the same age; but we will confine ourselves to bringing forward from Quetelet and Drobisch the comparison relating to suicides and criminals in France, both because it is the most homogeneous and numerous aggregate of facts, and because the exactitude and uniform source of the statistics, combined with the character of the legislation, give a greater certainty and importance to the results.

TABLE XXXI.—*Antagonism between Suicide and Crime.* (*According to Ages and Sex in France*).

Ages	Convicted 1826-44						Suicides 1835-44					
	Per million inhab.			Relative numbers per cent.			Per million inhab.			Relative numbers per cent.		
	M.	F	Cor. av.	M.	F.	Cor. av.	M.	F.	Total av.	M.	F.	Total av.
Under 16 years . .	3·8	0·6	4·5	0·2	0·2	0·2	1·3	0·4	1·7	0·2	0·1	0·2
From 16 to 21 years .	237	36	277	14·0	10·6	13·5	28·6	15·5	44·1	3·6	5·7	4·1
„ 21 „ 25 „ .	274	59	338	31·0	32·7	31·3	64·5	22·5	87·0	8·6	8·3	8·1
„ 25 „ 30 „ .	250	52	307									
„ 30 „ 35 „ .	227	43	274	24·2	23·9	24·1	78·1	21·9	100·0	9·7	8·1	9·3
„ 35 „ 40 „ .	182	38	223									
„ 40 „ 45 „ .	146	32	181	15·2	17·5	15·6	102·8	32·2	135·0	12·8	11·9	12·6
„ 45 „ 50 „ .	111	27	140									
„ 50 „ 55 „ .	80	17	97	8·3	8·8	8·3	106·7	38·1	144·8	13·3	14·0	13·5
„ 55 „ 60 „ .	61	13	75									
„ 60 „ 65 „ .	50	11	62	5·2	5·0	5·2	126·0	45·3	171·3	15·9	16·7	15·9
„ 65 „ 70 „ .	38	6	45									
„ 70 „ 80 „ .	23	4	27	1·4	1·2	1·3	148·6	48·7	197·3	18·5	18·0	18·4
„ 80 and upwards	8	0·3	8·8	0·5	0·1	0·4	147·5	46·6	194·1	18·3	17·2	18·0
Totals . . .	1,691	339	2,059	100·0	100·0	100·0	804·1	271·2	1,075	100·0	100·0	100·0

In a period in which the tendency to suicide was greatest at above 70 years of age, among men as well as

women, crime on the other hand in France furnished the greatest intensity before the age of 25, so that in delineating the two curves of these tendencies there would be found an inverse parabolic developement.

Man easily gives way to the instigation to crime when his physical developement is nearly complete; when the passions, and particularly the more expansive passions, reign with their natural impetuosity; and when reason has not gained the maturity fit to direct him in the misfortunes of life. In that period in which the imagination has the supremacy over the other mental faculties, there is often an expenditure of the energy with which the constitution is endowed in the directions opened by the worst instincts and brutish desires. It is only slowly, and after having been long in contact with society, that man becomes more indulgent towards others and more severe towards himself.

§ 3. *Civil Status.*

The study of the social status ought to follow that of sex and age, with which it is intimately connected. The usual error has been repeated here also, of inferring the more or less favourable influence of celibacy and marriage from the absolute numbers of suicides without thinking of the numerical difference existing in a population between the unmarried and those who are or have been in the conjugal state. And, indeed, it is necessary to keep count of the great preponderance of the single under 20 years of age, to attain an exact proportional comparison. In a population of 24,000,000, like the English, scarcely 36 per thousand men are married before their twentieth year, whilst among women at that age already 151 per thousand are married. It seems, then, that the advice of Oettingen

to eliminate all the individuals under 20 years of age should not be followed, because by so doing almost *two-tenths* of the married would be excluded, at any rate where there is a tendency to early marriage as in England. It is better to limit the exclusion to all children and young people under 15 years of age, and then to proceed to the proportional calculation per million of the remaining individuals. But statistics containing information on this important element of social life are scarce, and the most complete in this direction, we are pleased to say, are the Italian, of which we shall here prefer to make use.

At all times it has been admitted that celibacy had a disadvantageous influence in comparison with marriage, for it is evident that marriage shows the most beneficial influence on man's vitality, and that which happens to mortality in general is repeated as to suicide, except that the effects, as might naturally be foreseen, are still sharper, particularly in widowhood. But before demonstrating this influence by the diverse inclinations of the unmarried, married, and widowed, let us hasten to show the constant regularity of the general returns of their suicides in particular years and countries. Our Table XXXII. contains in regard to this subject a comparison between various countries, and especially the separate returns of recent years for Italy, France, and Prussia. The numbers of the divorced are given only for some German countries; thus the Saxon statistics divide the divorced (*Geschiedene*) from those separated from bed and board (*getrennt Lebende*), which we, however, have joined in one list. In Italy and France they keep no reckoning of the separated, although it is known that they contribute largely to voluntary deaths.

In considering the proportional numbers per thousand suicides, calculated on the actual numbers, we find the

TABLE XXXII.—*Influence of the Civil Status on the Tendency to Suicide.*

(*Proportions per Cent. for Sexes and for Civil Status calculated on Absolute Numbers.*)

Countries and Periods		Single M	Single F.	Married M.	Married F.	Widowed M.	Widowed F.	Divorced (and septd) M.	Divorced (and septd) F.	Unknown M.	Unknown F.
Prussia	1869–72	34·7	36·4	46·2	41·1	13·9	20·5	1·9	1·4	3·3	0·6
	1873	32·5	40·6	43·3	36·6	14·3	20·6	2·7	1·3	7·2	0·9
	1874	33·7	39·8	15·8	35·4	14·1	20·8	1·9	2·4	4·5	1·6
	1875	33·8	39·3	46·8	38·5	14·2	19·6	0·8	0·9	4·4	1·7
	1873–75	33·3	40·0	45·4	36·8	14·2	20·3	1·8	1·5	5·3	1·4
Saxony	1847-50	33·7	29·5	45·2	44·9	10·7	22·2	3·1	1·8	7·2	1·5
	1851-55	33·7	34·5	46·9	41·5	12·3	19·6	1·5	1·0	5·6	3·4
	1856-60	36·2	39·5	44·9	39·0	10·1	18·0	1·8	1·3	6·9	2·2
	1861-65	35·1	35·3	46·3	42·[illegible]	11·0	16·0	1·2	1·2	6·4	5·2
	1866-70	31·3	40·2	49·1	40·9	12·4	17·2	1·3	0·8	6·0	0·9
	1871-76	30·8	36·8	48·1	41·3	13·2	19·8	0·9	0·9	7·0	1·2
France	1863-66	30·3	25·9	48·6	51·4	15·1	22·7	—	—	?	?
	1867-71	35·8	26·2	47·2	48·7	15·8	24·4	—	—	1·2	0·7
	1872	34·0	21·8	47·0	46·0	15·0	25·6	—	—	4·0	0·7
	1873	35·6	25·7	45·2	49·5	14·7	23·0	—	—	4·5	1·8
	1874	56·6	27·2	46·4	49·5	13·9	22·4	—	—	3·0	0·8
	1875	32·1	28·5	50·4	48·3	14·8	22·6	—	—	2·7	0·6
	1876	34·7	26·6	45·1	49·3	15·9	22·3	—	—	4·3	1·8
Italy	1866	48·2	33·4	38·0	47·0	5·3	13·6	—	—	8·5	6·0
	1867	43·9	26·6	39·6	55·9	12·3	16·1	—	—	4·2	1·4
	1868	47·4	42·4	35·7	40·0	8·8	13·3	—	—	8·1	4·3
	1869	43·8	34·0	42·1	44·6	9·4	18·7	—	—	4·7	2·7
	1870	43·5	29·1	40·3	46·5	12·5	23·8	—	—	3·7	0·6
	1871	45·5	31·0	41·3	48·2	10·4	19·4	—	—	2·6	1·4
	1872	43·2	36·6	43·0	41·7	10·4	18·7	—	—	3·4	—
	1873	41·1	27·2	43·1	49·7	12·1	23·1	—	—	3·7	—
	1874	41·1	29·7	45·5	49·3	11·8	20·2	—	—	1·6	0·8
	1875	44·4	44·0	41·6	41·2	10·9	13·7	—	—	3·1	1·1
	1876	47·9	38·9	38·1	42·9	11·3	16·5	—	—	2·7	1·7
	1877	44·1	31·2	42·0	53·1	11·2	15·7	—	—	2·4	—
	1866–71	45·3	32·8	39·5	46·8	10·0	17·7	—	—	5·2	2·7
	1872–77	43·8	34·0	42·1	4[illegible]·3	11·3	18·1	—	—	2·8	0·6

unmarried to predominate *numerically*, although only slightly over the married; then come the widowed, and in Saxony, the divorced and separated; but with respect to the two sexes, the bachelors are predominant among the men, while on the other hand, in some countries (Italy, France, and Saxony) the proportion is greater of the married women than of the marriageable. Another sexual difference is furnished by the condition of widow-

hood, since widows are proportionally higher in number than widowers, so that in Italy the former reach half the number of marriageable women, the latter scarcely the quarter of the number of bachelors. The number of the divorced and separated in Saxony, although here derived from the statistics of thirty years, do not seem to differ much in the two sexes. Remarkable, too remarkable indeed, is the return of individuals of unknown status, but probably it is increased, in Italy and France, by many separations, legal or otherwise, and not only by the uncertainty in which the official registrar finds himself in face of individuals who are joined together only by th religious bond. Among others cases of suicide, destitute of any clue, are many caused by drowning, and many committed by persons unknown. Naturally, the number of women of unknown social standing is very small, both on account of the sedentary lives of women, and because they do not need to hide their own social condition so often as men. The figures vary little from year to year, if the aggregate of the most recent statistical periods are taken into consideration; nevertheless, the contribution of each return is not always uniform. The most uniform place in the annual returns of suicide is filled by the widows, who constantly surpass the widowers.

But the influence of the social condition, together with sex, appears still more clearly in the relative percentage between men and women of each of the four categories. Arranging in one table only some relative dates of various countries, and in order to spare the reader's mind reducing the report to the simple figures only, we perceive that, whilst the general relation of the two sexes varies very little from about 20 females to 80 males among the single, it is smaller for the women of Italy, France, and Baden;

larger for those of Prussia; and among the married, on the contrary, larger for the former, smaller for the latter.

Relative Percentage between the Sexes in the Civil Status of Suicides.

Italy	Single		Married		Widowed		Unknown	
	M.	F.	M.	F.	M.	F.	M.	F.
1866	86	14	77	23	61	39	85	15
1867	86	14	75	25	77	23	93	7
1868	81	19	77	23	70	30	88	12
1869	81	19	75	25	62	38	84	16
1870	84	16	76	24	65	35	96	4
1871	87	13	79	21	71	29	86	14
1872	82	18	78	22	68	32	100	—
1873	86	14	79	21	69	31	100	—
1874	81	19	74	26	57	43	86	14
1875	81	19	81	19	77	23	92	8
1876	86	14	82	18	78	22	99	1
1877	86	14	76	24	74	26	100	—
France								
1863–66	84	16	78	22	71	29	—	—
1867–71	84	16	79	21	72	28	89	11
1872–76	83	17	78	22	71	29	93	7
Prussia					Wid. and divorced			
1869–72	80	20	82	18	75	25	96	4
1873–75	78	22	83	17	76	24	95	5
Saxony								
1866–70	77	23	84	16	76	24	97	3
1871–76	78	22	83	17	74	26	96	4
Baden					Widowers			
1864–68	87	13	87	13	73	27	97	3
1869–73	84	16	85	15	80	20	95	5

But the most marked divergence from the normal is the state of widowhood; in all countries the proportional relation between the widows and widowers exceeds that between the spinsters and the bachelors, between the married women and married men, so that evidently *widowhood brings the woman nearer to man than any other social condition;* a fact which might be conjectured even before it was confirmed by statistics, although according to the researches of Bertillon the mortality of widowers everywhere, but especially in France and Belgium, surpasses that of widows. It is a fact that wars, making a

great number of widows, always raise the annual number of their suicides. • In making this careful search into the statistics immediately before or after the Franco-German war of 1870–71, we find a sudden leap in the suicides of the widows in France, Prussia, Baden, and Saxony from 1870–71 to 1872, greater than among the spinsters and wives.

But it is necessary to check the results of the actual figures by a reference to the population. A computation on the census must be made to find a uniform distribution of the annual geometrical augmentation of average on all classes of inhabitants, supposing the conditions of the population to remain unchanged from year to year, as in fact they do, when no great social disturbances take place, as wars, epidemics, or famines.

TABLE XXXIII.—*Influence of the Civil Status on the Tendency towards Suicide.*

(*Proportions per Million Inhabitants of each Civil Status.*)

COUNTRIES		Single		Married		Widowed		Divorced	
		M.	F.	M.	F.	M.	F.	M.	F.
Italy .	. 1873–77	86·6	19·8	71·8	20·1	168·6	29·6	—	—
		56·4		45·9		72·8		—	—
France .	. 1863–66	326·3	56·9	235·1	67·7	579·3	123·4	—	—
		184·2		151·7		279·5		—	—
" .	. 1865–66	343	57	237	59	641	127	—	—
" .	. 1863–68	273	59	245·7	62·5	628	133	—	—
		173		154·5		303		—	—
Saxony .	. 1847–58	?	?	481	120	1,242	240	3,102	312
Würtemberg	. 1846–60	?	?	226	52	530	97	1,298	281
"	. 1873–75	330		230		360		320	
Switzerland .	1876	410	56	449	71	817	76	(comp with the widowed)	
Piedmont.	. 1872–76	113·0	20·7	76·1	18·5	153·2	24·4	—	—
Lombardy .	. "	107·6	22·7	89·1	18·7	218·3	37·1	—	—
Venetia .	. "	91·9	24·5	113·0	34·4	195·6	51·8	—	—
Emilia .	. "	158·5	51·1	136·3	47·4	348·8	72·3	—	—

From the number of single people, those under 16

years of age are excluded in the French returns, those under 20 from the Würtemberg returns, and those under 15 from the Swiss and Italian returns (Table XXXIII.).

Looking at the aggregate of the two sexes, the pernicious influence of widowhood, divorce, and celibacy, and the good effect of marriage, is ratified. In fact, if we take the position of the bachelors and widowers in conjunction with that of the married men, which is the smallest, and which we will make equal to 100, we shall then get:

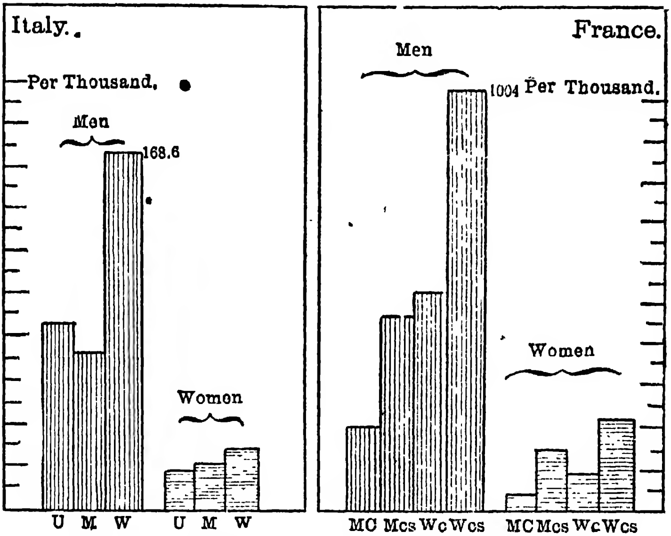
	Married	Single	Widowed	Divorced
In Italy	100	108	167	—
In France	100	112	196	—
In Würtemberg	100	143	156	139

But the differences of the sexes must be noted; whilst on men the hurtful influence of celibacy and widowhood is lasting, women, on the contrary, give in Italy, France, and Switzerland, fewer suicides in the single state, and more among the married and widows. In fact, in Italy the same number of men amongst whom, if they were married, there would be 100 suicides, would furnish if single 120 and 235 if widowers; whilst an equal number of spinsters, compared with 100 suicides of married women, would give only 90, whilst widows give 147. In France, if the loss by or probability of suicide amongst married men is represented by 100, that of the single becomes 111·4, and of the widowers 256; but reckoning the loss among married women as equal to 100, that of girls amounts only to 94, and among widows it rises to 213. Thus the unexpected result is reached, that widowhood increases the loss more among men than among women, and celibacy hurtful to the former is not so much so to the latter. The proportion of married women who inflict death upon themselves

deserves all the attention of psychology; it denotes that woman does not often find in matrimony the happiness of her youthful dreams.

On the other hand, the single have fewer motives which urge them to self-destruction, and neither should we forget another physical cause of suicide among the married,

FIG. 7.



Influence of the Civil Status (Italy) and of the Family (France) on the tendency to suicide.

U unmarried, *M* married, *W* widowed; *Mc* married with children. *Mcs* married childless, *Wc* widowed with children, *Wcs* widowed childless.

the frequent mental alienation during pregnancy and child-birth, against which the unmarried have only to set the shame of illegitimate child-bearing. It is, indeed, an exceptional fact that in Switzerland even the married men have more tendency, though only in a slight degree,

towards suicide than the unmarried. We do not fathom the reason of this, and our data belong to one year only.

The sexual differences in the divorced state are most important. Only during 1873–75 in Würtemberg the intensity of divorced was below that of the widowed and single; but in the same country during the much longer period of fifteen years, between 1846–60, and in Saxony, their probable loss by suicide appeared higher, to an extraordinary degree, than that by the other classes. Representing the loss of married men and women at 100, the following progressive numbers are found for widowhood and divorce:

	Men			Women		
	Married	Widowers	Divorced	Married	Widows	Divorced
In Saxony . 1848–57	100	258	644	100	200	260
In Würtemberg 1846–60	100	234	574	100	189	536

Divorce is then proportionally more harmful to man than to woman, particularly in Saxony; where the probable loss among the divorced men is *sixfold* that of the married, and more than *double* that of the widowers; among the divorced women, on the other hand, the loss is more by under a *fourth* of that among widows. But it is not so in Würtemberg, where, on the contrary, compared to widowhood, divorce becomes much more hurtful to woman.

Up to this point the civil status has been considered without regard to the age of the suicides; but, as Bertillon notices, it is useful to study the combination of that with the powerful influence exercised by each particular period of life, to each one of which very different moral and material conditions of the individual correspond in the single or married, among the widowed or divorced. On the other side, we find the readiness towards suicide in-

crease with years, but as on the whole the single average younger than the married, and these than the widowed, it is easy to understand how a part of the higher proportion offered by these last may be attributed to the influence of age. In fact, up to 15 years of age, the number of the unmarried already diminished by death begins to diminish still more by reason of marriage. Whilst the maximum of the unmarried is between 1 and 10 years of age, that of the married falls between 30 and 50 (variable in different countries), and lastly, that of the widowed is only beyond the age of 60. Whence it happens that in the most advanced period of life, the influence of age and that of widowhood combine together to increase the readiness for suicide of the widowed. With regard to the divorced, on the other hand, their maximum falling about the fifth decennial of life (in the German Empire), it may be supposed that their great suicidal tendency depends almost entirely on the influence of divorce, a very small part of it having regard to age.

Bertillon has studied the combination of age with the Registrar's returns upon the French data of 1863–68, and the following summing-up is the fruit of his investigation. The greater number of unmarried (that is to say, 58 per cent., exclusive of those under 15, who contribute only in the smallest degree to suicide) are between 15 and 20 years old, of married between 30 and 50, of widowed between 55 and 75; the first then have an average of 26·8 years, the second of 45·8, the third of 61 years. That being premised, and calculating on the numbers of the period 1863–68 (see Tables XXIX. and XXXIII.), the influence of age ought to have raised the average of the unmarried in France to **139** suicides *a year per million* of individuals, and about **250** of the married people; that is to say, that the probable loss by suicide, if it depended

only on age, would be much larger among married people than among single, in about the relation of 100 : 55·5. But exactly the reverse happens as the proportion of suicides is less among the married, being as 100 : 111·4. The influence of marriage as a preservative against suicide has, then, neutralized that of age by diminishing the probable loss of the married by more than one-half. It is less easy to estimate the influence of the state of widowhood by reason of the great increase of suicide among the old; the advanced age of widowers, however, is not the only cause of the phenomenon, since, if it were, their average would be between 406 and 511 per million; it reaches instead to 628, an evident sign that to the loss by age is joined that caused by widowhood.

The same laws repeat themselves for French women; the single, whose average age is 28·4, ought to sustain a loss of 42, but it amounts to 60; and the widows, who have an average of 60 years of age, instead of having the usual proportion of 116 for women at that age, go up to as many as 133 suicides per million, precisely because widowhood is, like celibacy, a powerful predisposer to suicide.

Applying this reasoning to Italian statistics, we are deprived, it is true, of information as to the average age of the three groups of individuals; but supposing it to be not very different from that of the French, we obtain a like result, except for widows. If the medium age of single men is put at 25 or 26, that ought to produce about 77 suicides per million, according to the proportions of age which we found for 1872–77; but it gives us an average of 86·6, about 10 more than the required numbers should be. As to the married people, their medium age put at 45·8 would produce a loss of 102 per million, with a relative proportion to that of the single = 135 : 100; in reality, however, their

loss is even below that of the single, namely, 93 : 100. The difference of 42 existing between the returns per cent., or of 31 between the theoretical average of 102 and the actual one of 71, represents the beneficial share exerted by the marriage tie on the inclination of the Italians towards suicide. Lastly, the widowers, in place of giving 140 per million, as their age would entail, furnish instead 148 suicides per million. Amongst women, the same method would show a slight disadvantage for the unmarried and widows (the medium age of widows is lower than that of widowers), and only a slight advantage for the married.

It may now be worth while to investigate whether the presence of children would be a sufficient check upon the inclination to suicide. Very few official publications contain this important datum; we will, however, quote the French, which divides the married and widowed with progeny from those without, and the Prussian, where those suicides are found separated who leave behind them relations needing their assistance. In France, the influence of a family over the inclination of the two sexes to commit suicide is as follows:

France, 1867–76	Men		Women	
	Actual numbers	Per cent.	Actual numbers	Per cent.
Married with issue	13,022	67·6	3,221	61·0
„ without issue	6,261	32·4	2,061	39·0
Total of married	19,283	100·0	5,282	100·0
Widowed with issue	4,122	65·8	1,517	59·4
„ without issue	2,144	34·2	1,040	40·6
Total of widowed	6,266	100·0	2,557	100·0

In Prussia, the suicides with relations in need of their help are thus divided, according to sex and civil status, remembering that the single are those above 15 years of age.

Prussia, 1869–75	Men		Women	
	Actual numbers	Per cent.	Actual numbers	Per cent.
Unmarried without needy relations . .	5,261	94·9	1,384	91·4
" with " " . .	286	5·1	131	8·6
Total of unmarried	5,547	100·0	1,515	100·0
Married without needy issue . . .	2,811	36·4	722	44·6
" with " "	4,929	63·6	899	55·4
Total of married	7,740	100·0	1,621	100·0
Widowed without children unprovided for	1,733	73·0	654	79·7
with " " "	639	27·0	188	22·3
Total of widowed	2,372	100·0	842	100·0
Divorced without children . . .	217	70·0	34	57·6
" with " . . .	93	30·0	25	42·4
Total of divorced	310	100·0	59	100·0

From these figures it will be seen that the presence of children is a stronger check for the *mother* than for the *father* in married life and widowhood, whilst it is the contrary in the state of divorce. This characteristic of the divorced confronted with the married women and widows must be owing to the frequent separation from the children, whose care and education are by law usually entrusted to the father. But the influence of a family is made still more evident by the actual numbers per million of individuals belonging to each state, as Bertillon junior has established (*Revue scientifique*, February 1879).

In our fig. 7 (at p. 233) the phenomenon is shown most clearly by France; the loss by suicide, which among the married with issue is 205 per million for the husbands and 45 for the wives, rises on the contrary among the childless marriages to 470 for the former and to 158 for the latter; the one doubled, and the other more than tripled in number. And with regard to widowhood, among men with children the probable loss is 526, and among women 104; but when

they are childless the number of suicides increases to 1004 among the widowers, to 238 among widows.

Let us recall the attention of the reader to the fact that the possession of children is a restraint upon the widows sufficient to overcome the harmful influence of widowhood, whilst the want of children raises the tendency in wives barren from whatever cause by one-third above the first class of widows. The abandonment, isolation, often misery, attendant upon widowhood, are continually overbalanced in woman by her sweetest and noblest affection, maternal love. Nor ought we to forget that many women find themselves happier in widowhood than they were in married life; so true is this, that they are much less eager to leave that condition by re-marriage than are widowers (Bertillon).

§ 4. *The Professions.*

The investigation of the influence of professions on human life and proclivities has much interest for the medical student, and professional hygiene forms the greater part of the daily medical code; not only in the department of internal and external pathology or racial, whether as concerns diseases bred by certain manufactures and arts, or on account of greater or less human longevity, but also because it affects the developement of the mind, the strength of the reason and its susceptibility of education, and the culture of the moral sentiments. We mean to say that also in the psychological field this branch of hygiene has struck vigorous root, and the proof of it is the more or less fortunate efforts to indicate to the legislator the tendency to crime in the different social ranks, to the alienist the more or less resisting power of some profes-

sions against madness, and especially against certain fixed types of it, lastly, to indicate to the sociologist the different inclination for suicide of particular professional classes. This last point has been investigated by many statisticians, from Casper, Petit, and Cazauvieilh, to Lisle, Friedreich, Kayser, Legoyt, and Wagner; but in truth the obstacles to arriving at any conclusion are so many that no available results have been obtained. Bearing in mind what uncertainty attaches to the professional statistics of a census, we shall not charge science with the errors based on such data. Only in ideal professional statistics as Mayr says, could all the necessary and exact information which even now we demand be registered at a future day. Under actual circumstances it becomes a matter of course that the study of the influence of professions on the suicidal tendency falls far short of adequate accuracy; at the most it must be confined to determining the regularity of social life even under this aspect, and approximately the greater or less probable loss by suicide in the well-marked and less variable professional categories only.

Those who with the largest collection of data have studied this subject are, as usual, Wagner and Legoyt; as skilful statisticians they have attempted to determine the question *by the relation to the number of those belonging to each profession.* However, it is only within the last years that a less inaccurate and more uniform professional census has come into use; yet still leaving such differences between the various States as to render a comparison most arduous and even impossible. Hence it is wiser to study each country separately; because although we have found more than one recent census reduced to groups fit for comparison by Professor Bodio (*Censim.* 1871, vol. iii. *Popolaz. classif. per professioni, Introd.* 1876), yet was it impossible for us to profit by his labours, owing

to grave differences in the professional categories. This part of our work must then be accepted as a preliminary study on the question, an essay, and nothing more.

Let us note before everything the regularity with which the separate professional categories contribute each year to the aggregate of suicides. We might reproduce here long columns of figures, but owing to restricted space, and also to create a desire in the reader to seek himself for the proofs in the official tables, we limit ourselves to some returns as to the professions of suicides in Prussia during the four years 1869–72. It is here also necessary to keep the sexes distinct, because there is no analogy between the kind and the numerical relations of the professions entered by men, and those in which women can occupy themselves. The following figures refer only to known cases, as do almost all the returns on suicide in Prussia.

The uniform annual distribution of suicides in the different professions is a simple effect of that same uniformity of social life through which a population cannot suddenly change its professional conditions, hampered as it is in its choice between limits imposed upon it by the nature, the topography, and the special products of the country which it inhabits. Almost always the uniformity of voluntary deaths shows not only the existence of these material influences, so to speak, but expresses also the different part taken by each category or class of individuals in the moral progress (psychological) of society of which it makes a part. It is presumable that the contribution, in this respect, remains uniform in the great mass of individuals, and we are confirmed in this opinion by each one of the professional categories having its own specificness in crime, madness, and even in suicide. This last may be investigated in two ways; either by confronting the different numerical position which belongs to all the several pro-

TABLE XXXIV.—*Influence of the Professions on the Tendency to Suicide.*

Professions of the Suicides in Prussia (numbers per thousand). Uniformity of the Annual Returns.

PROFESSIONS DIVIDED INTO CATEGORIES	Men					Women				
	1869	1870	1871	1872	1869–72	1869	1870	1871	1872	1869–72
Agriculture, pastoral	211·1	207·8	210·7	176·0	201·6	233·7	213·0	226·0	194·2	216·7
Forestry	5·4	5·1	4·6	3·0	4·6	3·2	3·2	3·7	3·4	3·4
Pisciculture	0·8	1·7	0·5	1·3	1·1	—	—	1·9	—	0·4
Mines and quarries	8·2	5·1	8·2	8·0	7·4	4·9	4·7	—	1·7	2·9
Constructions	74·3	72·4	77·4	61·0	71·2	30·8	30·2	37·0	32·4	32·5
Industrial productions	216·3	210·8	206·6	229·0	215·8	151·0	160·6	159·3	165·3	159·0
Commerce and Insurance	55·0	63·8	60·0	53·4	57·4	17·8	41·3	44·5	34·1	34·1
Railways (working and construction)	10·1	10·7	14·7	11·4	11·6	6·5	8·0	11·0	5·1	7·6
Posts and telegraphs	0·4	3·9	2·7	5·5	4·0	—	3·2	—	1·7	1·3
Marine	8·6	3·9	7·8	8·9	7·3	4·9	6·4	7·3	1·7	5·1
Despatch in all its branches	9·3	8·6	11·4	9·3	9·6	1·6	—	1·9	3·4	1·7
Landlords and innkeepers	15·6	13·3	12·4	16·5	14·5	11·4	15·9	16·7	13·6	14·3
Day workmen of undetermined professions	152·9	176·5	53·9	160·8	160·6	152·6	154·2	126·0	158·4	148·4
Domestic servants	4·0	4·7	4·6	4·2	4·3	13·0	4·7	7·3	6·8	8·0
Army and navy	67·0	46·3	64·6	85·0	66·0	—	3·2	—	—	0·9
Constabulary, police	4·7	2·6	2·3	2·1	3·0	—	—	—	—	—
All the other professions (liberal)	23·3	29·1	34·8	22·4	27·2	43·8	31·8	31·5	20·4	32·0
Capitalists, proprietors	19·8	25·3	16·9	17·4	20·0	29·1	36·6	40·3	23·8	33·7
Pensioners, life annuitants	28·4	30·9	28·9	30·6	30·0	39·0	62·0	29·5	39·2	43·0
Mendicants	10·1	15·4	6·1	11·4	10·9	11·4	19·1	20·4	15·4	16·4
Persons without professions	40·5	36·0	36·2	42·3	38·6	216·0	187·6	205·6	250·4	214·6
Provided for in public establishments	34·2	26·1	34·4	38·5	33·3	29·2	14·3	24·1	29·0	24·0
Total	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

fessions in the population in general, and in the returns of suicide; or better still, by calculating carefully the annual average of violent deaths per million of those engaged in each profession. The second method would give results more approaching exactness if the professional census did not leave so much to be desired.

In the following table (XXXV.) is displayed a specimen of an enquiry into professional influence, computed on the Italian statistics for the eleven years 1866–76. The categories of professions were extracted from the census of 1871, as is shown in the first part of the table.

It does not appear necessary to us to explain the constitution of these seventeen professional groups; we will only say that the 'dependents,' comprehended also in the census children under 15 years of age, but in the calculation of the proportions per million (third part of the Table) they were excepted, as we already gave notice in the section on age.

It was, indeed, presumable that those least disposed to suicide would be those the farthest removed from the difficulties of life, that is to say, those living at the charge of others, or without any profession (Cat. XVII.); their average is, in fact, much below that of the population in general, and more so among men than among women. Equally low is the probability of the classes addicted to agriculture, pastoral life, forestry (Cat. I.), although they appear to be raised above the normal in the female sex. Among country people, however, pellagra contributes to raise the numbers in Italy. The category also of the labouring people, for the most part composed of individuals not devoted to fixed occupations (porters, journeymen, labourers, ploughmen, shoeblacks, scavengers, grave-diggers, workmen without a trade, &c.), furnish few suicides; among the men the average of these is under

TABLE XXXV.—*Influence of the Professions on the Tendency to Suicide. A Specimen of an Enquiry into that Influence in Italy* (1866–76).

PROFESSIONAL CATEGORIES	A Proportions per 1,000 of the population			B Proportions per 1,000 of suicides (1866–76)			C Per million individuals belonging to each profession		
	M.	F.	A.	M.	F.	A.	M.	F.	A.
I. Production of raw materials	423·2	227·8	325·0	228·3	386·1	260·3	26·7	21·6	25·0
II. Industrial productions	143·2	101·9	122·7	232·5	184·5	222·7	80·4	23·0	56·7
III. Commerce	12·4	2·4	7·5	69·6	16·6	58·9	277·0	87·0	246·5
IV. Transport	19·5	0·6	10·1	38·3	3·2	31·2	152·6	(433)	154·7
V. Property, moveable and immoveable	30·6	26·5	28·5	106·7	92·5	103·8	172·8	44·5	113·5
VI. Domestic Servants	12·5	22·3	17·7	29·6	73·8	38·5	116·7	41·1	68·1
VII. Defenders of the country	10·8	—	5·4	88·0	—	70·1	404·1	—	404·1
VIII. Public administration	9·9	0·2	5·2	65·0	—	51·8	324·3	—	324·3
IX. Religion	8·8	2·2	5·6	9·5	1·07	7·8	53·5	6·0	45·3
X. Jurisprudence (1868–76)	1·9	—	1·0	6·9	—	5·5	217·8	—	217·8
XI. Medical Professions „	3·2	0·9	2·0	10·5	1·61	8·9	200·9	28·0	163·3
XII. Instruction, education „	1·8	2·1	2·0	18·3	3·21	15·2	355·3	19·5	175·3
XIII. Fine arts „	2·8	0·2	1·5	4·2	1·61	3·7	90·9	99·8	94·0
XIV. Letters and science „	1·0	0·02	0·5	9·9	—	7·9	(618·3)	—	618·3
XV. Vagrant professions	1·4	0·3	0·9	7·4	5·9	7·0	260·7	252·7	259·3
XVI. Industrial supernumeraries	34·5	13·9	24·2	25·2	17·6	23·7	36·1	16·1	30·9
XVII. Dependents, and without fixed profession	282·3	597·9	439·2	15·9	172·7	47·8	21·6	6·5	8·0
Unknown professions				34·0	39·6	35·2	—	—	—
Total	1000·0	1000·0	1000·0	1000·0	1000·0	1000·0	—	—	—

the general average, and among the women only slightly above it, but all the professions and trades which, by habits and muscular or psychical occupation, bring women near to man, tend to raise, and sometimes in an extraordinary degree, their inclination to suicide.

The opinion which regards suicide as more frequent among agriculturists and proletariats of the country than among workmen and tradespeople is erroneous; and, indeed, the influences of instruction, of urban life, of economical crises are much more felt by the labourers in the great centres. In general, however, the propensity to suicide among the industrial artizans (Cat II.) is little above the common average, and the disadvantage is somewhat less among men. It is said that elsewhere the working classes pay a heavy tribute to voluntary death, but we must not be surprised if Italian statistics do not support this fact. Italy is not an industrial country, and those large masses of workmen which are found in France, England, and Central Europe, whose depravity, corruption, and misery account for the high numbers of mad people, delinquents, and suicides, do not there exist. But if in the aggregate the workmen and artizans show an ordinary tendency, there are nevertheless trades which possess the mournful privilege of increasing it. We wished to enquire into the proofs of this for Italy also, and the average proportion per million of individuals for each of the principal industrial groups during the six years 1872–77 is as follows. The computation is made on the census of December 31, 1871.

Intensity of Suicide in the Working Classes in Italy (1872–77).

Groups of Trades and Industries	Number of suicides			Per million individuals		
	M.	F.	Total	M.	F.	Total
1. Tissues	77	81	158	87·1	16·2	26·9
2. Leather	9	—	9	87·5	0	—
3. Clothing	235	82	317	92·0	36·6	66·1
4. Toilet necessaries	47	1	48	206·8	(78)	200·7
5. Food	250	33	283	102·7	44·3	89·0
6. Builders and owners of houses and streets	210	1	211	68 6	(50)	68·0
7. Furniture	43	—	43	191·3	0	—
8. House utensils	21	—	21	76·7	0	—
9. Transport, saddlery, &c.	14	—	14	10·4	0	—
10. Fabrication of arms and ammunition	11	—	11	237·5	0	—
11. Metal industries	69	—	69	75·5	0	—
12. Machinery and different instruments	17	—	17	77·2	0	—
13. Scientific and musical instruments	10	—	10	281·9	0	—
14. Paper	7	—	7	70·7	0	—
15. Printing, lithographing, &c.	40	—	40	227·9	0	—
16. Chemical products	2	1	3	53·1	(103·2)	63·4
17. Objects of luxury	46	0	46	333·3	0	—
18. Lighting	4	0	4	173 1	0	—

One chief result which surprises is this; the largest averages are returned by those industries which correspond to the least urgent needs of life, and these are groups 17, 13, 10, 15, and 4. The largest is that of group 17, which includes workers in objects of luxury, goldsmiths, jewellers, ironware, and makers of objects in alabaster, pietre dure, jet, toys, &c. This industry is more subject than others to general economic changes, because every unfortunate phase in the public wealth lowers the demand for, and consequently the value of their products. On the other hand, the intensity is less in the industries of group 1 (weavers, spinners, cloth merchants, dyers and spinners of wool, silk, cotton and hemp manufacturers, &c.); of group 6 (builders, stonecutters, paviors, plasterers, street labourers, white-washers, and chimney-sweepers); of group 3 (tailors, hatters, seamstresses, shoemakers, glovers, washerwomen, ironers, &c.), although somewhat above the average, especially among women; of groups 8, 11, 12, and 14 (makers and mer-

chants of glass, earthenware, combs, sieves, brushes, pipes; founders, iron-workers, coppersmiths, tinkers, tin workers, paper, pasteboard, and ink makers, bookbinders, booksellers, stationers). The numbers increase in group 5 (millers, bakers, pastry-cooks, druggists, drysalters, dairymen, butchers, cattle merchants, poulterers, fishmongers, greengrocers, and fruiterers, wine merchants, cellar keepers, beersellers, spirit merchants, cooks, coffeehouse keepers, innkeepers, taverners, manufacturers and sellers of salt and tobacco); in group 7 (ebonists, turners, varnishers, mattress-makers, upholsterers, makers and sellers of furniture, frames, chairs, &c.), and lastly, in group 9 (makers of carriages and carts, saddlers, and farriers). Some averages for women are not worth attention, because they are drawn from too few numbers; nevertheless, we find the weavers give the smallest number of suicides, and, on the contrary, those who are skilled in food industries give the greatest.[1]

One class of persons which gives very few suicides consists of those devoted to religion, especially among women (nuns, convent maids, and lay sisters); and here the religious sentiment has less influence than retirement and removal from the disappointments and passions of the laity.

The greater probable loss by suicide in the Italian population affects the remaining professions. Confronting the proportional contribution which they pay to this kind of death (letter B, Table XXXV.), and the part which concerns them among the population (letter A), the greatest calamity is found in the so-called ruling classes, and, above

[1] We give in a note some approximate figures on the million, calculated by Wagner for the French industries:—Millers 97, bakers 116, butchers 164, tailors 191, shoemakers 109, workers in textile industries 150 men, and 26 women; workers in metal industries 260; tanners and saddlers 400 (?)

all, in the liberal professions and trades. First of all are the literary, scientific, journalists, engineers, geometricians, all those in short who make the greatest use of their brain power.

Next come the military, of whose very high inclination towards suicide we shall speak in the following section, and then the true professionals, tradespeople, and all those reckoned in the 'vagrant professions.' Elsewhere some of the highest averages have been found in the category of domestic servants (Wagner), but the divergence may depend upon the different extent given to the category of domestic service; for example, in Prussia, besides the menials and servants, the workmen who cannot be classified elsewhere are placed there, but who ought to be reckoned among the agricultural day labourers. It, nevertheless, is the case that in Italy, at least, domestic service has a moderate tendency to suicide, although above the normal in both sexes, and particularly in the female.

The numbers are very serious among professionals, and especially amongst professors, masters, assistants, teachers in institutes, and tutors; and amongst those employed in public and private offices, in the custom house, tax-gatherers in municipal offices, jails and places of public security, ushers and attendants. This fact gives much cause for reflection to those who are not ignorant of the unhappy and now proverbial condition of these well-deserving classes, and particularly of teachers in Italy. This drawback, to speak the truth, does not follow us in the examination of the returns of women; schoolmistresses, teachers in institutions, governesses, have but little inclination towards voluntary death, which circumstance may be a conclusive argument for those who in the reform of education would desire to give preference to women in the primary schools.

As to the commercial classes, the financial crises of our times, the increased bad faith and the desire of immoderate gains, explain the large tribute paid by these classes to suicide; and it is not only the small dealers who swell this tribute, but the higher commercial classes also—bankers, merchants, and traders.

With respect to jurisprudence and the healing arts, their average is still higher in Italy, proportionally speaking, than in France and Prussia. The two categories differ little, but the average is somewhat less high among those who follow the medical professions; but whilst in jurisprudence beside advocates, notaries, and procurators, only the ushers (1,193 in 25,986) are counted, in the other category, beside physicians and surgeons are placed chemists, phlebotomists, overseers of infirmaries, and veterinaries, without which addition it is presumable, from the known disposition of doctors to become mad (Verga), that the average would be higher. Certain it is that in the upper classes of society the act of suicide spreads daily, owing to the direct ratio it has with the increased over use of the brain power. And it is natural that those who enjoy the greatest advantages of the psychical evolution of our times should also have to suffer the chief disadvantages from it.[1]

We will give briefly some of the most important results of the statistics of other countries.

The French statistics of suicides give the professions arranged in a different method from the Italian. In fact, up to 1868 many industries and professions (especially

[1] Here are some averages for the cultivated classes in France (Wagner): 185 officials per million; schoolmasters, literary men, students, artists, 157; advocates and physicians, 101; proprietors and capitalists, 182, regard being had, let it be understood, to the individuals of the whole family.

operative) were specified, but now the lists are reduced to only nine, of which here follow the number and proportion per thousand in the decennial 1866–75:

France, 1866–75	Number of suicides		Per thousand	
	M.	F.	M.	F.
I. Husbandmen and shepherds	15,133	4,513	367·2	419·9
II. Workers in wood, leather, metal wire, stones, glass, &c.	8,054	417	195 4	38·7
III. Bakers, pastrycooks, butchers, millers, pork-butchers	1,011	90	24·5	8 4
IV. Hatters, wig-makers, tailors, upholsterers, laundresses, &c.	1,920	900	46·6	83 7
V. Merchants, commercial travellers, agents	1,688	244	40 9	22 7
VI. Commissioners, porters, carriers, sailors, boatmen, &c.	924	7	22·4	0 6
VII. Hotel-keepers, inn-keepers, spirit merchants	684	123	16·6	11 5
VIII Domestic servants	1,191	722	28·9	67 3
IX. Liberal professions, officials, students, military, priests, proprietors, &c.	7,463	1,007	181·1	93 8
X. Rag-dealers, beggars, prostitutes, those without professions, and professions unknown	3,148	2,723	76·3	253·4

According to Legoyt (1856–60) the middle classes and outcasts furnish the most suicides in France (596 per million), almost three times as many as given by the liberal professions (218), about five times as many as the industrial (128), and sixfold the number of tillers of the soil (90). In the last period of returns, 1861–66, the proportions would have been on the same scale, according to Block, since on the million of inhabitants of each category we find:

	M.	F.	Average	M. : 100	F.::378
Agricultural professions	131	34	82	—	—
Industrial and commercial	196	35	117	—	586
Liberal and official	389	43	214	—	890
Without professions	695	543	610	—	102

The census for sex being wanting, we have attempted to make a calculation upon the table of the official publication previously given. During the quinquennial 1872–76 there would have been, according to this approximate

calculation, the following proportions per million for the primary professional categories :—Production of raw materials, 110·6 ; Industry, 158·9 ; Commerce and transport, 98·0 ; Domestic service, 82·9 ; Liberal professions, 510·0 ; varying employments, without profession or dependent, 28·3. From which it appears that in France also the unhappy pre-eminence belongs to all the cultivated classes.

In Switzerland, on the contrary, it concerns domestic servants ; the following are the official returns for 1876 :

SWITZERLAND, 1876	Actual numbers		Per thousand individuals	
	M.	F.	M.	F.
Production of raw material	125	12	304	73
Industrial productions	178	10	577	52
Commerce	33	2	664	89
Transport	33	—	1,514	—
Liberal professions, science, arts	20	—	558	—
Servants, day labourers, &c	41	9	1,981	92
Without, or unknown professions	44	33	—	—

As for Prussia, notwithstanding that the statistics give the most ample and precise information on the professions of the suicides, we were not able, owing to the want of a census, to arrive at any exact result. In the actual figures, those depending on industries preponderate (269·6 per thousand), the agriculturists (204·4), persons with varying employment (174·0); and a long way behind comes commerce (55·6), transport (45·3), the military (44·2), the liberal professions (41·4), and lastly come servants (5·2), whilst in the absolute proportions those engaged in professions and commerce appear to exceed all the other classes.

In Saxony, of which we possess the actual data for thirty years uninterruptedly (1847–76), the regular contribution made by each of the professional categories is

wonderful, as the following proportions per thousand from quinquennial to quinquennial will truly show:

Kingdom of Saxony		1847–51	1852–56	1857–61	1862–66	1867–71	1872–76
Husbandmen, peasants, workmen, commercial men, &c.	M.	742·0	719·5	745·6	749·2	736·3	754·8
	W.	506·0	459·5	503·4	458·9	512·8	500·0
Domestic servants	M.	60·1	58·2	49·1	44·9	54·8	47·1
	W.	192·7	231·7	199·9	212 4	214·2	215·6
Officials and underlings	M.	34·5	37·3	34·3	34·3	31·8	37·7
	W.	19 3	28·2	12 1	26·4	22·6	29·1
Masters and artists	M.	20·2	14·1	14 3	14·1	15·8	16·4
	W.	12·0	9·2	15·6	21·7	9·0	9·3
Military and camp followers	M.	37·8	50·1	47·1	39·6	41·1	28·1
	W.	2·4	—	1·7	—	—	1·3
Without profession and paupers	M.	63·5	83·5	6[illegible]·8	65·6	67·1	63 4
	W.	250·6	239 2	222·2	[illegible]81·4	114·6	171·9
Unknown professions	M.	41·9	37·3	45·8	52 3	53·1	52·5
	W.	17·0	32·0	45·1	99 2	126 7	72·8
Total	M. and W.	1000	1000	1000	1000	1000	1000

But we know almost nothing as to the absolute intensity. Judging by the different proportions of the professions, it would appear that whilst the working and country classes are 50 per cent. of the population, there are instead 47 per hundred among the male suicides and 27 among women; the industrial and commercial classes about 36 per cent. of the former and 26 and 20 per cent. of women. Domestic service, on the other hand, gives 0·69 among men and 4·42 among the women of the population, but among the suicides the numbers are 4·71 and even up to 19·31 respectively. In fact, Wagner nevertheless says that the servants exceed by **2,170** per million (**486** among women); then come afterwards the military with 640. Of the industries the average would be 310 among the men and 61 among women; among the workmen, 300 and 49 respectively; in the cultivated classes and liberal professions 385 and 77; but amongst the officials they mount to **540**; very high, however, would be the average of individuals without professions (790 men and 448 women); but such figures, as also those already returned by Legoyt and Block

for the French suicides, appear to exist because all the unknown individuals who are found dead by suicide are thus classed.

In Würtemberg the statistics of the three years 1873–75 give us important data; besides the proportion for each category of professions, a calculation is made as to what would be the result if all the dependents, that is to say, the members of the family of each worker (*Haushaltungs-Angehörige*), were deducted.

WÜRTEMBERG	Total population per category	Unproductive element (the family)	Per cent of the dependents	Suicides per million individuals	
				On the whole category	On workers only
			Per cent.		
Agriculture . . .	611,000	386,000	63	190	510
Industrial . . .	724,000	427,000	59	160	380
Commerce and traffic .	154,000	86,000	54	230	510
Service	132,000	80,000	61	110	270
Army	12,000	1,000	8	660	730
Officials, liberal professions	103,000	62,000	60	140	340
Without professions .	83,000	33,000	40	40	60
Total . .	1,819,000	1,075,000	59	170	410

The predominance of the military is here evident, then the commercial class, and (an exceptional case) the agriculturists. The liberal professions and domestic servants will be found among the lowest, but little above those individuals without a settled profession.

In Denmark also the latter category gives few suicides (Wagner), whilst as usual the tendency among the military and domestic servants is the highest. In Sweden and Bavaria, on the contrary, the governing classes again take the wretched lead; in Spain the middle-classes and labourers among the men, sempstresses and artists among women, take the lead, whilst, according to the actual numbers, the contributions of the professionals, military, and servants would be less; but the data are far from approximate.

It would be a matter of high interest to investigate the influence of urban life joined with the professions, but no statistics, except the Danish, which have already been drawn upon with little advantage by David, give us opportunity for such study. According to the meagre and insufficient signification of the absolute numbers of Denmark (1845–56), suicide increases in the towns particularly among tradespeople, soldiers, professionals, capitalists, vagabonds, and the suspected (*bedenkliche classen*), and, on the other hand, it decreases among agricultural labourers, servants, and children. We notice, however, that the Danish statistics place among the domestic servants all the helpers in field work, the boys and labourers at a fixed wage who, in other places, are classed together with the country-people. The heaviest loss in town life is seen among the tradespeople, who count 8 per thousand of the suicides in the country, 56 in the towns in the aggregate, and 72 in Copenhagen, and among the capitalists and pensioners, whose average per thousand of the total is respectively 4, 7, 29.

With respect to the large towns, in Paris the highest share would be taken by the domestic servants (servants, coachmen, porters, cooks); by the military, professionals, especially the officials, the prostitutes, and individuals without fixed professions. In the working classes, the strongest tendency is found among the tailors, seamstresses, and dress-makers; then among laundresses; nor is the average less high among traders in general, and hotel-keepers in particular. The smaller averages are given by proprietors, porters, bakers, pastrycooks, and gardeners (De Boismont). Let it be noticed, then, that the high proportion of suicides in the great centres, which are the abode preferred by the upper classes and the military, inclines us

to assume what might be the effect of town life, joined with culture and professions, on moral tendencies.

§ 5. *Social Condition.*

The influence of the social condition arises partly from that already spoken of with regard to professions, only the exclusive information with regard to them will not explain the precise position of the individuals within the professional group which they belong to, nor show what is the part taken by each in the collective activities, as director or simple actor, producer or consumer, master or auxiliary, or merely a member of the family of the professional. Such an investigation, whose social and psychological importance ought to escape nobody, we have no means of making from the statistics, except from those of Prussia, and as far as regards the economical condition also from those of Bavaria. In Bavaria, indeed, the suicides of persons in good or bad circumstances are distinguished, but from the moment when the corresponding conditions of the population are unknown to us, the returns become useless. Seeing, however, that from 1844 to 1867 the proportional number of the poor and the well-to-do in the Bavarian statistics remained constant, compared also with a uniform number of individuals of unknown fortune, we should be induced to acknowledge here also another phase of the really wonderful regularity of social phenomena.

Of greater comparative interest is the difference shown in the Prussian statistics of the social condition of suicides. Setting aside the question whether it is the best, it is certain that the data have a clear signification, especially those which refer to individuals who are dependent upon others. We give a summing-up for the period 1869–75.

It might be foreseen that the dependents of each pro-

fessional category would be most numerous amongst women, especially in the social upper classes (1), and in the industrial (3). Amongst the men, then, the suicides of individuals dependent on others, exclusive of the last category in which are found prisoners and paupers, are an insignificant part of the whole, which is as much as to say that it is fathers of families, heads of houses, those who receive wages, who have to struggle against the difficulties of life, who most easily leave it of their own accord.

SOCIAL CONDITION (Prussia 1869-75)	Actual numbers		Proportion per cent.	
	M.	F.	M.	F.
1. Living by the produce of wealth, professions, industry, &c.	4,700	498	278·6	120·8
Persons dependent on them	174	848	10·3	205·6
2. The governing class, administrative, inspectors, &c.	677	24	40·1	5·8
Persons dependent on them	20	102	1 2	24·7
3. All other industrial employments except servants	8,576	974	508·2	236·1
Persons dependent on them	61	398	3·6	96 4
4. Servants of all kinds	354	657	20·9	159·5
Persons dependent on them	1	15	0·06	3 6
5. Public officials	188	—	11·2	—
Persons dependent on them	7	19	0·4	4·6
6. Military and naval	997	—	59·1	—
Persons depending on them	—	2	—	0·4
7. All other individuals with ill-defined social condition	1,131	588	66·4	142·5
Total	16,878	4,125	1000·0	1000·0

Two social conditions are deserving of separate study; these are the military and prisoners, amongst whom, notwithstanding so many material and psychological differences, there exists the similarity of restraint exercised by discipline on individual will. It has already been seen in almost all the statistics, that the heaviest tribute to suicide is paid by the military; in Italy, whilst on the total of the population they constitute 5 per 1000, the suicides amount to 70 per 1000, that is to say, to a ratio fourteen times larger. Military life has the misfortune of increasing the loss of active and vigorous elements by means of unhappy

sacrifice to suicide. Whether that is owing to distance from home and disgust for military life, or to the severity of discipline, this is not the place to discuss; but in the meantime, wherever the psychological conditions of the army are studied there the heaviest, and we may even say, an exceptional loss may be perceived. And in the comparison which may be made between the soldiers and sailors of different countries, there is such a similarity of data that a still greater value must be attributed to the psychological interpretation of the numbers. The military service is, in fact, everywhere, except in England, regulated by the same rules of conscription, and of the obligation of the citizens, and everywhere the social and material condition of soldiers is equalised, either by custom and rule, or, which is more important, by disciplinary orders.

According to Wagner, the mortality by suicide amongst the military would go step by step with that of servants, but to us it appears, studying the returns carefully, that facts do not bear this out. One thing which should be remembered is, that the general mortality of soldiers is above that of civilians, who, at a corresponding age, are in the military service, notwithstanding that the physical constitution of the army by means of a careful selection of the strongest and most healthy ought to be guaranteed beyond the rest of the population against the probable loss by death (Oesterlen, Schimmer, Meynne).

The figures of mortality by suicide are quite in accord with the general returns, especially in the armies of the centre and north of Europe. In 1868 the following comparative statistics were published ('Gaz. de Voss,' and 'Union Médicale,' July 22): In the North of Germany there was 1 suicide out of 2,238 men; in Denmark, 1 in

3,900; in Saxony, 1 in 5000; Baden, Norway, and Prussia had each 1 in 9,000; Würtemberg 1 in 9,748; France 1 in 10,000; Sweden and Bavaria 1 in about 15,000, and Belgium 1 in 17,800. Nor is this contradicted in studying other statistical periods. In Denmark alone, the frequency amongst civilians exceeds that among the military, but the difference is so small (388 and 382 respectively in 1845–56) that Wagner justly excludes them, the more so because the officers are there distinguished from the ranks. In Sweden, on the contrary, in 1851–55, against 118 suicides of civilians, there were 450 military, in the ratio that is of 100 : 423. Amongst the soldiers of the kingdom of Saxony, in 1847–58 the mortality through suicide was 640 per million, whereas among civilians it was scarcely 369; thus on 100 suicides of the latter, there were 177 of the former. Under similar conditions Würtemberg gives us 170 among the men of the population, 320 belonging to the army, that is as 100 : 192 (Schimmer).

In France attention has been paid to the suicides of the army, which have become much more frequent during the last twenty years. In the period 1862–67, the extreme number was 510 per million of the forces, when it was 194 in the rest of the masculine population, and in Paris, the centre and fomenter of the suicidal tendency over a third of France, it rose to only 400. But allowing for the co-efficient of age, it is found that against the intensity of men between 20 and 30 years of age of that period (134 per million) compared to 100, that of the military would have been equal to 373. It appears, then, that the probable loss by suicide augments regularly in direct ratio with the time passed under arms, so that it is three times as great among soldiers who have been in the

service fourteen years (910 per million), as among men who have served under three years in the military life (300). It must be added that the French officers show for this kind of death an aptitude twice as great as that of the privates and non-commissioned officers.

In Prussia, from 1849 there was a difference of from 150 to 419 per million (100 : 293) between civilians and the military, nor has it fallen since. In the three years 1867–69 those who died by suicide were 0·6 per 1000 of the forces and 0·62 in 1872. Such returns confronted with the 600 and 620 per million is much above the average 394 of the male population, between 20 and 30 years of age. But it is in Austria-Hungary and Belgium that the loss in military life reaches its maximum. Already, in 1851–57, against 82 civilians the Austrian soldiers gave 444, with the enormous difference of 100 : 643, but in later years the mania for suicide appears to have reached a monstrous standard, since in the five years 1869–73 we find the mortality at 0·85, 0·97, 0·82, 0·88, 0·81 per 1000 of the forces, or the average of 866 per million against only 122 of the civil population. But we have already stated how terrible is the increase of these deaths in Austria. With regard to Belgium, in 1868–69 the suicides among the troops were 0·450 per thousand, whilst they were scarcely 0·068 in the population (662 : 100).

Mr. W. H. Millar gives us valuable information on the English army. From 1862 to 1871 the mortality by suicide was 0·379 per 1000 of the forces, and comparing it with that of men between 20 and 45 years of age, which during that period was 0·107, we find it of more than *triple* intensity. This intensity, moreover, augmented as time advanced; from 1862 to 1871 it grew from 278 per

million to **400** (in the first quinquennial an average of 315, in the second 443), and even reached **569** in 1869.[1]

The tendency, then, increases with the sending away the troops from Europe, so that in the kingdom (*at home*) the number is 339 per million, but in the English possessions in India it rises to 468. We may suppose that here nostalgia and the fatal influence of the climate play a large part. With regard to the diversity according to the arms, the unfortunate pre-eminence of the divisional corps (0·864 per thousand of the forces) and of the cavalry of the line (0·498), is a fact which agrees with what Lever said as long ago as 1839, lamenting the high mortality by suicide of the English dragoons, when it also was actually **785** per million (*Journal of the Statistical Society*, Vol. I.) The artillery follows with 0·343, the infantry with 0·309, the foot guards 0·209, the engineers 0·178, and the household cavalry 0·164. Taking into consideration the ages of the suicides among English soldiers, we thus learn the harm of prolonged service, because the mortality by suicide, as well as that from any other cause, rapidly increases every five years from 20 to 40 years of age. We think it may be useful to give the reader the comparison of the two kinds of mortality per 1000 of the forces (1861–70).

[1] These are the annual returns of the English army according to Millar:—

Year	Average army	At home	Abroad	Total	Proportion per 1000 of the forces
1862	193,174	21	33	54	0·278
1863	192,611	22	42	64	0·322
1864	186,388	24	56	60	0 321
1865	179,594	21	30	51	0·269
1866	170,015	28	40	68	0·377
1867	169,399	25	45	70	0·413
1868	169,662	36	43	79	0·466
1869	161,788	33	59	92	0·569
1870	153,978	22	35	57	0·370
1871	169,795	27	41	68	0·400

English Troops	Suicides			Ordinary deaths		
	Native country	Colonies	India	Native country	Colonies	India
Ages from 20 to 25 years .	0·20	0·21	0·13	5·85	8·57	15·02
" " 25 " 30 " .	0·39	0·33	0·39	7·84	14·52	22·97
" " 30 " 35 " .	0·51	0·45	0·84	13·64	16·15	31·06
" " 35 " 40 " .	0·71	0·81	1·03	19·02	26·89	42·04

In the Italian army, also, death by violence increases every year; and among the officers above that of the privates to an extraordinary degree. The suicides of the quinquennial 1871-75 on the annual average of 11,316 officers were 32, or **565** per million; amongst the privates 230, or **276** per million, and in all the troops under arms 262, answering to **294** per million. This is sufficient to demonstrate that the numbers of the military in Italy is almost tenfold that of civilians in general, five times that of the men, and four times of men only between 20 and 30 years of age.

On the suicide of prisoners, summing up what our other works said on that subject published in 1875 and 1877, we may say that the class of delinquents (suspected prisoners, accused or condemned) have more inclination towards suicide, as also towards madness, than the ordinary population, and that this kind of death even continually increases amongst prisoners. It is, however, necessary to keep the judicial prisons distinct from the true convict prisons, because in the former the intensity reaches a degree unheard of among the most frequent suicides of the suspected and accused. The following are, in fact, the average proportions for the two kinds of prison establishments in the principal European countries, calculated on the *Statistique pénitentiaire internationale* (1st year, 1872, Rome).

Suicide among the Prisoners of Europe (1872).
Comparison per Million of the Prison Population.

	Prison M.	Prison F.	Convict Prisons M.	Convict Prisons F.
Denmark	40,320	41,320	1,470	0 s.
Saxony	8,500	4,340	1,780	0 s.
Belgium	1,950	0 s.	1,740	0 s.
Netherlands	1,370	0 s.	0 s.	0 s.
Prussia	—	—	720	400
Sweden	0 s.	0 s.	600	0 s.
Hungary	—	—	400	0 s.
England	1,110	290	350	0 s.
France	750	420	80	340
Italy	160	680	270	0 s.
Austria	0 s.	0 s.	220	0 s.
Switzerland	0 s.	0 s.	0 s.	0 s.
Ireland	580	1,540	0 s.	3,090

The Danish and Saxon prisoners are more numerous than all the others, as is the case indeed in these two States over the whole of Europe; thus this pre-eminence is only a grave exaggeration of a common fact. It may have been seen how heavy the loss among prisoners is when compared with the general returns in each country, since only in France do the male prisoners in the galleys and correctional establishments give a smaller average. The scale of the intensity amongst prisoners does not equal that of the general population, so that we find the Belgian and Dutch prisoners in the third and fourth places, whilst Belgium and the Netherlands, it may, be remembered, have a low average. We still find the deaths by suicide almost always more numerous amongst the prisoners in the jails than amongst those in convict prisons, which still more confirms the close relation there is between madness, crime, and suicide, the three great corrupters of the human mind.

Let us recall the reader's attention to the increase of the proneness to suicide of women prisoners, which either equals or surpasses the number of men (in Denmark, Italy,

and Ireland), or has at the least always a very high average, which is never found in the free feminine population. It appears, then, that imprisonment and crime combine to change many other social and personal characteristics of suicides in prison. Suicide is more frequent amongst young prisoners under 30 years of age, but according to the returns of the population at large, it always preponderates amongst the single and childless widowers. Peasants give 54 per cent., and the proportion of the workpeople and servants is yet higher; whilst the number among the liberal professions is few (in Italy 1866–74). It is noteworthy that those guilty of crimes against the person make up more than half of the suicides in the prisons, and those only suspected of crime reach 38 per cent. of the total; we shall find very frequently amongst the determining motives for suicide in general, shame and remorse for crimes committed, or fear of judicial condemnation. Also in the penal establishments, the habits of an active and laborious life seem to diminish the outbreak of the tendency, since 70 per cent. of the suicides of prisoners are by those without work. Then the proportion is heavy (about 10 per cent.) among those afflicted with nervous diseases, hallucination, hypochondria, epilepsy, syphilis, affection of the tubercles, which agrees with the opinion so vigorously maintained by Despine in France, Thompson, Nicholson, and Maudsley in England, Lombroso and Virgilio in Italy, that degeneration or criminal psychoses affects the constitution in all its functions, from the cerebral to the morphological.

With respect to external influences, that of punishment must be remembered, because it is those sentenced for life or to a long period of forced labour who most frequently cut short their existence, whilst the suicidal tendency diminishes the longer the stay in prison is endured

and persons become used to imprisonment, which most of them do in the first six months, or the first year of punishment. They are always the warm seasons, which assist in the developement of the tendency, as is the case with madness also. Lastly, the question of the correctional system has been examined at length by us in the works mentioned, and we must confess that *solitary confinement of the suspected and accused produces a greater proportion of suicides than associated imprisonment and the system of mixed prisoners.* At Mazas in France the suicides are in a ratio of 1 to a thousand, that is **1000** per million (Lecour), at Louvain in Belgium they are **3,200**; at Amsterdam **1,700**; at the *Aagebert* of Christiania **800**; and on examining the aggregate of the penal establishments of Europe, the following differences per million of prisoners are found:

Cellular system: Belgium 3,610, Denmark 2,690, Great Britain 1,090, Italy 2,590; total average **1,370**.

The Auburn system: Great Britain 290, Italy 1,120; average **400**.

Mixed system: Great Britain 590, Saxony 1,360; average **800**.

Associated system: Austria 180, Hungary 370, France 130, Italy 170, Prussia 700, Sweden 660; aggregate average **350**.

It is clear that the solitary system causes the greater loss, although Baillarger, Lelut, Tocqueville, Moreau, Starke, and the French Parliamentary Commission of June 1875, have maintained through their reporter Béranger, that 'solitary confinement cannot be pronounced injurious to the mind and health of the prisoner.'

The conclusion to be drawn from all this is that the great predisposition for suicide, as well as for madness and crime, is a psychical attribute of the degenerate class of

imprisoned criminals, depending without doubt upon their own physical organisation. It is certain that a large part of the criminals feign suicide in prison (Nicholson); but counting only the cases effected, it may be maintained that the social class of prisoners is the most inclined of all to voluntary death. This is an analogy between crime and suicide which ought to stay the hand of those who think of raising it against themselves.

CHAPTER VI.

INDIVIDUAL PSYCHOLOGICAL INFLUENCES.
(DETERMINING MOTIVES.)

THE study of the biological and social conditions of individuals has led us now to the study of the motives which induce them to leave this life voluntarily. The fault attributed to statistics of wishing to examine the phenomena of conscience has respect especially to the causes of suicide and crime; and it is certain that in treating of phenomena susceptible of being variously estimated, caution is necessary, nor is it possible to reason from such figures with blind faith. The number of individual motives is immense, as is also that of human wants and desires, to which there may be a corresponding awakening, or a disgust capable of disordering the mind, and it is precisely the multiplied subjectivity of internal phenomena which renders this part of our thesis difficult and often hazardous. The French statistics of suicides, for example, enumerate about 60 causes, the Italian 25, Des-Étangs 15, De Boismont 20, Lisle 50, whilst Wagner reduces them to 14, Oettingen to 10, the Bavarian statistics to two or three groups of 4. It is natural that, on the one side, a list of shades of distinctions, while it corresponds to the variety of facts, has also the inconvenience of fatiguing the attention, and, on the other side, the grouping together, according to a more or less artificial category, although helpful at first to

the understanding of divers kinds of motives, yet leads to forced and inexact classification.

Certain kinds of causes, then, engage the different predilections of compilers of statistics; thus in the Italian the specification of moral causes shows great deficiencies. The heading 'Domestic Troubles' is simple in the Italian works, complex enough in the French, where they are distinguished by such headings as 'Grief for the Loss of Parents or Children,' 'Grief Caused by their Ingratitude or Bad Conduct,' 'Disputes on Family Affairs,' 'Reprimands by Masters,' &c. Thus, again, when it is only said 'suicides caused by *tædium vitæ*,' very different cases are probably united under this heading. Neither 'monomania' nor 'mental alienation' is one single cause in itself; it is possible to pass from political and religious exaltation to the most profound melancholia, through a thousand psychical phases which statistics neither do nor can estimate. And the origin, often quite ordinary, of certain mental phases, registered as mere presumptive causes of suicide, shows the weakest side of this part of statistics. Notwithstanding such defects, we shall find something spring out from the so much despised tables of the 'determining causes.'

The origin of the causes of the suicidal frenzy has already been explained by great and celebrated men, amongst whom it will suffice to name Brierre de Boismont; but our book is a study of comparative statistics, from which every sort of ethical and philosophical disquisition must be excluded. However, in order to show the plausibility of the numerical method in experimental psychology, we will give our opinion on individualism in the motives for suicide and on the difference between 'physical causes' and 'moral causes.'

§ 1. *Motives for Suicide and Determinism.*

It is asserted that the existence of individual motives destroys collective determinism in demographic phenomena, because it seems to those who glance superficially that the part taken by the individual exceeds that belonging to the numerous social, historical, ethical, and biological influences which we have previously studied. When it is proved (so it is argued) that the suicide had domestic troubles or a reverse of fortune, that he struggled in vain against fate or against the bad conduct of his wife, may it not be presumed that the fatal act was preceded by a free exercise of reason, and that the determination to suicide was taken after a *choice* made by the will between life oppressed with sorrow, and death, the extreme term of misfortunes?

The question appears to us exactly turned upside down. If a motive is so strong and decisive as to *determine* men to suicide, it is already, through physiological laws, the *necessary* cause of a natural effect; the existence of a logical process constructed of premises and consequence is a proof of the necessity of the act, which if it were not preceded by ratiocination would be the act of madness. In the latter case, perhaps, instead of a ratiocination it would be a sophism, but in treating of a normal or pathological process, the moral action does not escape the law of causality which rules over all phenomena, and hence also over the human conscience. Where there are laws, spontaneity cannot exist, since if it could, the mind must be able to overpass the limits granted to it by its physical condition, which is simply absurd. Not being able to demonstrate *positively* that the determination of the individual springs independently from the physical

substratum (the grey matter of the brain), we ought with a quiet mind to accept the corollary of psychological physiology that the 'idea of *free will* in the human microcosm agrees with that of the doctrine of chance in the universal macrocosm' (Herzen).

Certain it is that the existence of personal motives, being the first fact perceived by common observation, prevents the recognition in the apparently free human action of those fixed laws which are concealed by the endless number of individual peculiarities. The same thing happens when we wish to judge *by the senses* of the stature of an homologous group of men, which appears irregular only to those ignorant of the laws of man's developement, the differences of sex, age, and race, and the regularity with which individuals are arranged in series so as to be able to know beforehand, as is done every day in levying conscripts, the average size and number of each of them (Quetelet.) Notwithstanding it is said by many statisticians who, perhaps by opening the door to their science at a yet early age of metaphysics, did not dare to arrive at the true signification of the discoveries of that science, that the approximate number of crimes and suicides during one year in one group of men may no less be foreseen *when their intrinsic and extrinsic conditions do not vary*, although there is nothing more *voluntary* than homicide, theft, violation, and suicide. We have purposely mentioned varieties of conditions in which social phenomena exist, because every human act is the product of thousands of tendencies and counter tendencies, more or less *concealed*, which co-operate towards the objective result *perceptible* to our senses. Civilization would be impossible if man, instead of *being obliged* to be what he is, could transform himself according to his *will*.

This appears strange to those who believe that moral

actions depend upon the individuality of each human being, not on the general conditions under which society exists; but perhaps even in suicide the same regularity of racial phenomena is not found. For example, in finding that amongst births there is constantly the *same* prevalence of males, the *same* proportion of multiple parts, there is no difficulty in recognising in it a 'natural complex law' (Süssmilch), which nevertheless does not manifest itself in the characteristics of every particular case. It is the same with regard to voluntary deaths in an unchangeable group of men, amongst whom for each period there is found a given number through madness, through physical suffering, misery, and by heritage. Yet in each suicide individual peculiarities seem to predominate, and nothing remains of the universal conditions. The attempts at homicide and theft, Buckle observes, can be, and are by good fortune repressed, but a plan of suicide is rarely prevented. The man who has made a determination to leave this life eludes every expectation, he remains beyond the vigilance and the intervention of others, and his suicide becomes an isolated act belonging to him who has accomplished it, without any person extraneous to the psychical process, from which the first idea of it was developed, having participated in it. Suicide therefore appears to be the most direct product of will, and differs in this from crime, that its motives rarely proceed from outside, and are generally the most subjective, the most intimate which can be imagined.[1]

But whilst it happens generally as an isolated event, which law cannot foresee, nor of which the compassion or justice of men can stop the execution, it depends upon the influences of all kinds already mentioned by us:

[1] In some cases the idea of suicide arises suddenly in the mind, and the act follows without the individual having the power to restrain himself. The phenomenon depends upon cerebral automatism.

since by *changing these influences* not only are the general returns of violent deaths modified, but those internal and external motives, which influence the determination of the individuals for or against this act, are also changed.

It follows from this that the personal motives of suicide have quite another importance from that which it is wished to attribute to them in the struggle between metaphysical freedom and scientific determinism. Since humanity, *as long as the actual conditions remain permanent*, must pay its tribute every year, it is natural that each man quits life from motives peculiar to himself. But these motives or 'causes' are regularly and constantly the same for men or women, for young or old, for Italian or English, for the physician or the peasant; each one of these individual states has also a specificness in its own determinations, since, as Quetelet and Buckle say, and whatever may be the aspect of *poetic* and *prosaic marvellous* (Block), under which this theorem appears, 'given a certain condition of a social society, a determinate number of individuals must put an end to their own existence.' Each human being may be compared to an orbit described around a multitude of foci formed by the biological characteristics of the individual, by education, by the conditions of public justice and public morals, in short by all the material and moral atmosphere in which the life of man is passed. Only by breaking away from the yoke of these influences can man be called free.

But let us observe a little more closely the causes of suicide, and we shall find that they can only be those produced by *the law of averages*, nature, and differences. The number of voluntary deaths caused by mental diseases, by disorders of the brain nourishment, by the perversion of the moral and intellectual faculties, is considerable. The existence of so many 'physical causes' deserves the atten-

tion of the psychologist; where does madness begin and where does reason end? Who can mark the limits between the normal and morbid function of the brain? This is not a work in which inopportune discussions of the relations between madness and suicide can be repeated. The idea of psychical abnormity is sufficient for those who are accustomed to look at the many weak sides of human reason; it is, on the contrary, insufficient for those who are alarmed at these directions taken by psychology, especially on the judicial ground, where they appear to prejudice ideas held by most people as the palladium of morality and justice. But without concerning ourselves with the psychiatric question, and without enquiring whether the injustice is due to Esquirol, Falret and Bourdin, or to Lisle, Moreau de Tours, and De Boismont, let us ask what sociological signification have the statistical facts gathered every day, and we shall find that a great part of the suicides are commonly ascribed to mental aberration, whilst at least in half of the cases of madness the idea of suicide is sometimes concealed under the troubled appearance of delirium, sometimes towers amidst the ruins of an unhappy mind. A very close link, it cannot be denied, exists between these two morbid manifestations of mind, but just as madness may go on without any attempt at suicide, so the suicidal determination is formed in the healthiest minds, which then carry it out with the coolness inspired by the most perfect logic. And what follows? Even accepting the opinion of Leuret that suicide is the effect either of madness, or want, or crime, we do not see that the edifice of determinism is destroyed nor the idea invalidated which we advanced of its being a social phenomena as necessary as alienation itself, crime, prostitution, and misery.

The 'physical causes' undoubtedly exclude all indi-

vidual spontaneity (in the metaphysical sense); the motive, however, is subjective, more internal than any other, developing itself in the brain or in the organism without any fault or participation of the moral external world. The list of these cases would be still greater if we were able to estimate the psychical condition of many unknown and concealed suicides. The very existence of so many actions *not free*, renders questionable also the spontaneity of those caused by presumed 'moral causes,' amongst which, after diligent enquiry, we can find none which might not be reduced to morbid modifications of the mind. What, indeed, is weariness of life and disgust of existence, but a form of hypochondria and sometimes of melancholia. Misery, nevertheless, is to be ascribed more to physical than moral causes, brought about either by grave nutritive disorders of the brain, by enfeeblement of the constitution, and hence of character, or by the general hyperæsthesia of the nervous system, produced by the anæmic condition. The etiology of mental alienation is continually being enriched on the subject of physical causes, from heredity to traumatisms, from infectious maladies to depravity of character, from bleeding discrasia to delirium of the sensorium, and to disorders of the powers of motion, whilst then, not even accepting the exaggerations of the school of Jacobi, the list of moral causes diminishes at every advance of psychiatrics. We believe that if it were possible to know exactly the physiological temperament of all self-destroyers, and, above all, the hereditary transmission, direct or indirect, of the morbid germs, we should be able to trace back the fatal determination of their last act to its true and efficient cause.

Nevertheless, after all reductions being made, there yet remains the moral sufferings, baulked ambition, vanity, passions, jealousy, and shame, in which it would seem that

the independence of the individual of external influences ought to show itself. But surely it needs no proof to show that the personal motives are a small and infinitesimal portion of the collective motives. Each man has his part in the evolution of humanity; each one has his own passions and wishes to satisfy, but only because these follow the common course and are developed in a prescribed atmosphere. The individuality of our wants and our tendencies is absorbed in the aggregate of social wants and tendencies. That the share of each particular person be definable in this sense or in that, that each has a special orbit and goal, that each contributes his part towards the common action, does not preclude the combination of individual activities into one. The motives which impel the suicide to quit life are not beyond social laws; indeed, man would never have destroyed himself if he had lived far from other men and had not shared in the misery of his fellow-creatures. The more humanity advances, the more it tends to the common association of forces; therefore, in the metaphysical sense, the savage appears to be freer in his virgin forests than the civilized man in his splendid cities. We cannot move without collision, without meeting limits, without arriving rapidly at the boundaries of the circle assigned to us; our wants are not satisfied if they clash against the interests of others, and these enclose and press around us like a circle of iron, to which, in the pettiness of our unmeasured pride, and almost to conceal the cruel truth, we give the vain-glorious names of 'duties of one's own position, exigencies of morals, education, judicial order.'

The ruling direction of the desires and wants of society guides in all ages that of human actions; this is proved not only by history, but by all statistical laws, where all great moral phenomena are resolved into their true

character, as expressions of collective energy, by means of individual energy.. It is certain that in all mankind the expenditure of energy happens differently; it is a hard but unavoidable consequence of human evolution and of unconscious natural selection, that there are some who are weak, degenerate, and defenceless, in whom only the basest passions are developed, such as egoism and the lowest wants, under the form of depravity and balked ambitions. Every want of man, although necessary to his perfection, involves victims. A want of nutritive necessities entails madness, suicide, crime, which are displayed among the middle and decayed classes. The erotic needs find them in the many repulsed by sexual choice, in girls betrayed by lovers, in family dishonour. The intellectual wants among the upper classes find their victims sometimes in the ruin of the ambitious, sometimes in the awakening of those hurt in their dearest affections. We see the tide of suicide rise with the growth of mental culture, and every year which passes, new wants arise amidst the civilized classes to which afterwards, without their will having any part in it, humanity must pay a tribute of new victims. To the ancients it was political fanaticism that was harmful, exaggerated religious sentiment to the middle ages, and it is vanity which is harmful in our own age; we allude, let it be understood, to 'moral' motives. The historical transformation of the personal motives for suicide shows that the individual conscience modifies itself with the change of the general conscience, and, indeed, it is but a part of it. Assuredly in every suicide we are surprised by different modalities from those of the others, but it is not by stopping short at the observation of a single planetary body alone that astronomy was able to establish the laws of the cosmic structure; and so it is not by investigating the apparent

disorder in single cases or in small series of cases, that the regularity of social life can be illustrated; but, as the theologian Süssmilch remarks, by a large collection of data.

§ 2. *Physical and Moral Causes of Suicide.*

The regularity with which even in presumed causes of suicide the same numbers are repeated from period to period, would be evident in the long statistical series which we would cite if space were not wanting. But we limit ourselves to summing up in Table XXXVI. a comparison of several countries where the constant and uniform appearance of certain groups of 'motives'—for example, psychopathy—appears, indeed, in very dissimilar statistics.

The groups of Table XXXVI. deserve some elucidation, because the statistics which we possessed were thus rendered more homogeneous and fit for comparison. We have here followed the example of the Saxon and Prussian statistics, besides those of Wagner and Oettingen; thus we reduce the categories to only *ten*, although VII. and VIII. might even form a single one. In I. all the *psychopathic conditions* are included, that is to say—alienation, delirium simple or typhomania, brain fever, monomania, melancholia, madness, pellagra, imbecility, cretinism, religious exaltation (in the case of Norway we add besides religious scruples), political fanaticism, &c. In II. *physical diseases*, painful illnesses—long, desperate, and incurable. In III. *weariness of life* (*tædium vitæ*), in general akin to the psychopathic conditions, but separated in all the statistics; discontent with one's condition, disgust to military service, craving in general, and nostalgia. In Number IV. all violent *passions*, crossed love, jealousy, avarice, anger. In V. the *vices*, libertinism,

drunkenness, and alcoholism. Number VI. is perhaps the largest, since besides *domestic troubles* it includes all *anguish of the affections*, opposition, and dissensions in family or office, the loss or absence of beloved people, indignation at unjust reproofs, bad conduct of relations, delusive hopes, &c. In VII., all *financial derangements*, by the loss of employment, or by gambling, reverse of fortune, the missed inheritance, and lost law suits. In VIII. we reckon *misery* and the fear of it, the lack of food and work. Very large is Category IX., *remorse* and *shame* appear there, the fear of condemnation, or of judicial enquiry, illegitimate pregnancy, the false sense of honour, shame for having committed criminal actions, and the frequent suicides after homicide, infanticide, arson, &c. In the last, X., *despair*, the causes which are not included in the preceding categories, and lastly, the large number of the 'unknown.'

At first sight we are struck by the high proportion of the mental disorders, and of the others relating more or less to the morbid condition of the constitution. In Italy, reckoning *tædium vitæ*, a secondary form of the true melancholia, along with mental alienation, pellagra, and physical diseases, about 50 per cent. of *known* cases are due to pathological causes. An equally grave number was found in the statistics for madness; Petit and Lisle in France assign to this cause about the *third*, De Boismont in Paris about the *seventh*. Even Block, suspicious as he is of suicidal statistics, confesses that, whilst in England the jury and the coroner are almost always inclined to assign the fatal act to an aberration or brain fever, about a *third*, however, in all countries, with a regularity worthy of attention, are attributed to madness or to monomania; 300 per 1,000 in France, 333 in Prussia, 348 in Saxony, 470 in Belgium, 313 in Italy, 400

Table XXXVI.—*Presumed Causes of Suicide*
Proportions per 1,000

Determining Causes	Sweden 1852–55	Norway 1856–65	Norway 1866–70	Prussia 1869–72	Prussia 1873–75
A.—Men					
Number of cases	557	1,092	699	9,450	7,426
I. Mental disorders	397	142	179	295	229
II. Physical diseases	45	—	—	53	61
III. Weariness of life, discontent	6	104	103	119	127
IV. Passions	21	28	4	21	27
V. Vices	309	100	25	99	129
VI. Afflictions, domestic troubles	15	42	21	41	48
VII. Financial disorders	121	167 (VII–VIII)	103 (VII–VIII)	34	41
VIII. Misery	4			39	35
IX. Remorse, shame, fear of condemnation	82	54	46	125	103
X. Despair.—Unknown and diverse	—	366	518	174	109
B.—Women					
Number of cases	122	336	222	2,372	1,753
I. Mental disorders	517	250	284	484	441
II. Physical diseases	82	—	—	72	64
III. Weariness of life, discontent	—	143	104	71	97
IV. Passions	50	30	13	46	63
V. Vices	90	9	—	22	21
VI. Afflictions, domestic troubles	24	74	18	50	51
VII. Financial disorders	58	38 (VII–VIII)	45 (VII–VIII)	8	12
VIII. Misery	24			16	18
IX. Remorse, shame, fear of condemnation	155	71	31	131	108
X. Despair.—Unknown and diverse	—	384	505	99	125
C.—Both Sexes					
Number of cases	679	1,428	921	11,822	9,179
I. Mental disorders	418	167	204	333	269
II. Physical diseases	52	—	—	57	61
III. Weariness of life, discontent	8	111	103	109	121
IV. Passions	28	29	7	26	34
V. Vices	270	78	19	83	109
VI. Afflictions, domestic troubles	18	50	21	43	49
VII. Financial disorders	109	137 (VII–VIII)	89 (VII–VIII)	20	36
VIII. Misery	7			35	32
IX. Remorse, shame, fear of condemnation	94	58	42	126	104
X. Despair.—Unknown and diverse	—	370	515	159	185

in several States of Europe.
of the Two Sexes.

Saxony			Würtemberg		Baden	Belgium	France			Italy	
1847–56	1857–66	1867–76	1846–50	1873–75	1853–56	1840–49	1836–52	1851–60	1866–75	1866–71	1872–77
3,575	4,521	5,995	1,400	—	263	—	39,210	18,713	39,915	3,483	3,770
300	302	304	(209)	—	297	—	216	263	252	237	280
66	58	59	192	—	114	—	90	108	127	70	82
65	104	97	(190 ?)	—	—	—	65	52	45	35	43
12	18	17	14	—	19	—	30	23	17	52	49
143	134	96	—	—	38	—	112	129	149	14	12
21	21	26	97	—		—	111	118	138	75	96
43	36	32	168	—	407	—	104	83	65	134	170
101	60	46	—	—		—	67	48	48	58	101
127	130	89	130	—	125	—	74	82	64	28	42
121	137	234	—	—	—	—	131	94	95	297	125
957	1,227	1,432	390	—	64	—	12,797	5,749	10,035	899	1,195
532	555	534	(157)	—	468	—	372	439	415	408	417
85	64	86	158	—	125	—	91	108	118	101	73
41	53	48	(151 ?)	—	—	—	48	40	29	12	7
19	28	45	23	—	91	—	59	56	45	96	75
35	29	20	—	—	—	—	53	55	56	[illegible]	1
38	33	29	77	—		—	133	127	164	76	90
—	4	1	204	—	188	—	29	25	18	19	27
43	22	23	—	—		—	50	30	36	39	52
118	134	74	227	—	125	—	59	56	52	21	27
80	78	140	—	—	—	—	106	64	67	226	231
4,532	5,748	7,427	1,790	840	327	2,428	52,007	24,462	49,950	4,382	4,965
348	356	348	(200)	401	331	470	255	304	285	272	313
70	59	64	186	59	116	18	90	109	125	77	80
60	93	87	182	(85)	—	37	60	49	41	31	34
16	20	23	17		34	124	37	30	23	61	55
120	112	81	—	275	30	94	98	112	130	11	9
24	24	27	92			106	117	120	143	75	95
33	29	26	175	(85)	364	109	85	69	56	110	136
89	52	42	—				63	44	46	51	89
125	131	86	148	95	125	41	71	76	61	26	38
115	124	216	—	—	—	—	124	87	88	282	151

in Würtemberg. During 1846–50, as many as 432 per 1,000 suicides in Bavaria, and during 1857–66 up to 482, were affected with madness or physical infirmities.

With respect to the prevalent forms of madness, De Boismont, amongst his 4,595 suicides, has been able to distinguish it in 652 cases, in which predominates (131) the homicidal and suicidal monomania. In other statistics, we sometimes find the simple heading of 'alienation, delirium, monomania, mental diseases;' sometimes, on the contrary, various forms are very definitely distinguished, as in Italy, Prussia, and France. The proportion of monomaniacs amongst Italian suicides is so much above that of the mad in general as to justify the suspicion of an excessive readiness in ascribing this unfortunate act to this kind of madness. In fact, impulsive monomania afflicts scarcely 2·40 among the madmen, and 1·87 amongst the mad women shut up in Italian asylums (Verga); on the contrary, in the aggregate of suicides which happened from 1866 to 1877, there were the following forms of madness:

Italy 1866–76	Actual numbers			Proportions per cent.		
	M.	F.	Total	M.	F.	Total
Mental alienation, delirium	1,076	451	1,527	57·3	52·2	55·6
Monomania	182	91	273	9·7	10·5	9·9
Pellagra	541	290	831	28·7	33·5	30·3
Idiocy, imbecility	52	19	71	2·7	2·2	2·6
Brain fever	30	14	44	1·6	1·6	1·6
Sum total	1,881	865	2,746	100·0	100·0	100·0

Monomania would therefore appear to be five times more frequent among suicides than among the mad, but in truth it is of all alienations of mind the most difficult to recognise. Monomaniacs mature their fatal project while hiding delirium, until they suddenly startle the family and society by some extravagance, and often by

some fatal action in evident relation with morbid ideas. The instinctive impulse in other cases arises without delirium, and makes itself so much the master of the individual will as to draw the worthy man to homicide, the prudent and courageous to suicide. But in these, notwithstanding that the symptoms of true delirium are wanting, the reflective and sensitive faculties are not perfect from the moment that the impulse has power to weaken and conquer them; thus it is plain that all the mental energy is then concentrated on the morbid action, and instead of a delirium in the ideas or senses it is the will which is possessed by it under the form of a convulsive relaxation of the sensitive and psychological faculties, as epilepsy is of the encephalic motive cause. For these reasons the monomania, whether intellectual or whether impulsive, must have a large share in the etiology of suicide, but probably its influence is exaggerated by calling many afflicted with melancholy and hypochondria monomaniacs.

In France the same error is committed, in our opinion, since, with the exception of pellagra, the distinction of the psychopathic conditions of suicides is the same as the Italian; and in the period 1866-75 we find 585 monomaniacs (4·1 per cent.), of whom 455 were men (4·5) and 130 women (3·1). Nevertheless, in that country the cases of melancholy are separated, although, contrary to rule, they are less numerous than the monomaniacs (3·8 per cent.) Brain fever is more frequent in France, exactly double what it is in Italy (3·2), which arises from ascribing less rarely the delirium of suicide to an acute disease of the brain. The suicides of idiots also mount to double the number amongst the French.

The better conditions of scientific culture in Germany shows itself in like manner in distinguishing suicides from madness, where we see the melancholy slightly predomi-

nating, and the undetermined relegated to the last place. In Saxony, during the thirty years 1847–76, and in Prussia during the nine years 1866–75, the suicides from madness are classed as follows:

Form of Madness	Saxony 1847-76				Prussia 1866-75			
	Actual numbers		Per cent.		Actual numbers		Per cent.	
	M.	F.	M.	F.	M.	F.	M.	F.
Religious exaltation	14	6	0·3	0·3	27	10	0·[illegible]	0·5
Monomania	—	—	—	—	31	9	0·7	0·5
Melancholia, hypochondria	2,832	1,239	66·6	63·5	2,989	1,267	67·0	66·0
Brain fever, typhomania, fever, &c.	—	—	—	—	2[illegible]	37	4·7	1·9
Madness, mania	1,111	594	26·1	30·4	256	41	5·7	2·1
Mental excitement	297	116	7·0	5·8	—	—	—	—
Imbecility, idiocy, cretinism	—	—	—	—	186	109	4·2	5·7
Other forms or not named	—	—	—	—	763	449	17·1	23·3
Total	4,254	1,955	100·0	100·0	4,461	1,922	100·0	100·0

We are not able from these data to make a comparison, for any country, between the prevalent forms of madness among suicides and those among the demented, of whom generally the smaller part are those brought into asylums. The morbid forms which preponderate amongst the Italian mad people who are shut up are for madness 20·75 per cent., and for mania, with or without violence, 18·62 (Verga). On the other hand, simple melancholia was 9·35, pellagra 8·04, with slight difference between the sexes. Of all the other forms none rise above 3·60 per cent. But amongst the mad who are at large it may be presumed that the proportions are inverted for many kinds, dementia perhaps being excluded; for example, those suffering from pellagra, epileptics, idiots, cretins are much more numerous among those at large than among those under care.

The Italian statistics say nothing concerning the relation of suicide to melancholia; the Prussian and Saxon, on the contrary, show that two-thirds of the voluntary deaths are owing to melancholia or hypochondriacal conditions;

it may be said that in Italy the place of these is taken by those who are mad through pellagra, which, moreover, has many characteristics in common with lipemania. The numerous cases of weariness of life or nostalgia, discontent with one's own state, disgust for life, fatigue of physical suffering, and lost hope of cure, approach, without doubt, to the melancholy conditions. In all these, a uniform base is found; depression of the sensitive faculties, exaggeration of the egoistical sentiment, perversion of general sensibility, by means of which life is changed into an insupportable load, and all the affections become dead. Antipathy to existence is a real illness of the brain, it is a morbid modification of the conscience and of the affections, which may often indeed be accompanied, as in Leopardi and Byron, by the brightness of a powerful intelligence, but which more often weakens the character and debilitates the moral sense.

It is probable that suicides through mania may be the least frequent, because this form rarely passes unobserved on account of incoherence of ideas and extravagance of acts shown, and the prompt consignment into an asylum forestalls every dangerous accident. As to the mad, their contribution would, on the contrary, be great both on account of their number among those at large, where, being always a burthen on the family, they are less looked after, and because in madness the impulse towards suicide is all the more fatal, as the reflective faculties are less in a condition to estimate the consequences of the act. The small number contributed by the half-witted (idiots, imbeciles) in all countries is noteworthy, since they form the larger part of the mad among the population. In Italy, among the suicides they amount to 5·86 per cent. of men, and 8·56 per cent. of women; but at the census of 1871 they counted 73·0 per hundred among men of weak mind and

36·0 amongst the women. In Prussia, their proportion among suicides is still smaller (from ·4 to 5 per cent.), whereas, on the contrary, they make 61·5 in the total of mad people. But the rarity of suicide amongst the half-witted is accounted for by the small part taken by them in social and family life.

Let us now proceed to consider the general relation of suicide with madness in the whole of Europe, where these two moral diseases of the age augment with equal steps. In the north-west and centre, the proportion of the mad rises to its *maximum*, exactly as does that of suicides. There are calculated to be annually about 300,000 mad in the whole of the Old World, and the greater number are found in France, Germany, and England. According to the works of Legoyt, Osiander, Hausner, and Guttstadt, the scale for mental diseases in the various States is not very different from that of the suicides. At their head stand the countries of Germanic stock, with about 2 mad people in 1,000 inhabitants, then the Celto-Romans with 1 per 1,000, and lastly, the Slavo-Tartars with 0·6 per 1,000. In the following table we institute a comparison among different States (Table XXXVII.), and although the numbers of the mad are already antiquated, and the census made unequally in the different States, yet from the aggregate of these countries it is established that those which are pre-eminent for madness have also a high number of suicides; and it is worth noticing the constant superiority in numbers of Denmark, Saxony, and Schleswig, and of the German countries in general. Strange, on the other hand, is the position in respect to Italy occupied by France, Bavaria, and Sweden, but may not this arise from the registration of idiots and imbeciles? It is still doubtful whether in North Italy those suffering from pellagra at the end of 1871 were returned in the

census as *mad*, because they are not yet accustomed in the Italian country districts to recognise the mental symptoms of pellagra, except when the sick person is at the last extremity. It is here that the usual error is committed of considering the functional state of the brain as independent of the morbid conditions of the constitution.

TABLE XXXVII.—*Relation of Madness with Suicide.*

COUNTRIES	Mad people		Suicides		Number of order	
	Year of the Census	Per 100,000 inhabitants	Period or years	Per million inhabitants	For the mad	For the suicides
A.—States.	(Oesterlen)					
Norway	1855	310	1851–55	107	1	8
Würtemberg	1853	312	1846–56	108	2	7
Denmark	1847	280	1846–50	258	3	1
Saxony	1858	261	1856–60	245	4	2
Iceland	1845	260	1846–50	(260?)	5	(4)
Schleswig-Holstein	1845	250	1856–60	209	6	3
Prussia	1871	215	1866–70	133	7	5
Scotland	1858	185	1856–60	34	8	14
Hanover	1856	170	1856–60	131	9	6
Italy	1871	164	1869–73	31	10	15
Ireland	1851	150	1831–41	14	11	16
France	1851	130	1851–55	100	12	9
England	1860	116	1856–65	69	13	12
Bavaria	1857	110	1846–56	73	14	10
Sweden	1850	100	1851–55	71	15	11
Belgium	1842	100	1841–45	62	16	13

It is a gross tautological sophism to give the title of 'moral suffering' to sorrow for a misfortune, to misery, privation, crossed love or jealousy, whilst they reserve the title of 'physical suffering' to pain which arises from a mechanical injury, from an irritation of the peripheral nerves, or disease of the intestines. The cause is unequal, but the effect is the same; it has regard to a modification of the nutritive state of the brain in both cases. The expression of moral suffering is the same as that of physical suffering, because every abnormal condition of the nervous sensibility disturbs the functions of the constitu-

tion. Thus it happens that the reactions after suffering, whether it concerns traumatic lesion or the loss of a relation, are everywhere alike; in the groups of muscles, in the respiratory and motor-vaso phenomena, in language, in tears, in psychical disturbances (Mantegazza, 'Espressione del dolore,' *Arch. Antrop.* 1875). And what is a heavy sorrow if not a violent sensation, subjective, originating in the psychical cells, through which, in obedience to physical laws, the reactionary energy in proportion to the intensity of the impression is discharged? 'Every excitement caused by grief, whether it is created by the conscience or not, whether it arises from external influences or from internal sensation, always modifies by means of the transformation of the forces and that of sensation, the physico-chemical condition of the nervous centres; and the change is expressed by different actions of the functions, which may be by tears, sobs, delirium, religious susceptibility, blasphemy, crime, or suicide, according to the temperament and education of the individual. The first philosopher who has understood the true nature of suffering is Herbert Spencer ('Essays, Scientific and Political,' 2nd series, 1863, p. 109), whose psychological school, based upon physiology, admits that in a given moment the quantity of free nervous force, produced in us by the quality called sensation, *must* show itself in some way, producing an equivalent manifestation of force in more rapid thoughts, in exalted ideas, disordered movements, cries, howls, despair, diarrhœa, paralysis of the heart. Such reaction is so *necessary*, that if it fails, or is not possible, the suffering would destroy the soundness of the brain.

For us, then, there is no difference between physical and moral suffering, because in the same degree as suffering and prolonged diseases are fatal to mental health, so

is a sorrow which happens suddenly or lasts persistently. And thus it is that physical pain enters among the causes for suicide for about 8 per cent. in Italy, 13 in France, 19 in Wurtemberg, 10 in Norway, and 12 in Prussia. The most acute physical suffering, owing to the accumulation in the blood of an abnormal quantity of carbonic acid, darkens the intellect so far as to cause it to fall into crime or rage; after which comes an exaggerated reaction for the discharge of the excessive tension of the brain, and re-establishment of the equilibrium, a reaction driven on even to suicidal phrensy. This refers always to extremely painful illnesses, or incurable affections, for which the physician has declined all responsibility, but in both cases there is an enfeeblement, progressive anæmia, and insufficient food for the brain. Chronic and diathetic diseases, cancer, syphilis, misanthropy, the slow affections of the spinal cord, and above all of the locomotor ataxy, affections of the bones and of the skin, and disfiguring wounds, often throw the unfortunate sufferer into despair, so that the idea of suicide is at the first rejected with horror, whilst under delusive prospects of improvement, but afterwards tolerated, and finally welcomed, it ends by triumphing, developing itself in a mind weakened by suffering, or rather in the weakness of a brain already hurt by the progress of disease. According to Prussian statistics, physical disease, by which in the four years 1869–72 were caused 671 suicides, are divided thus between the two sexes:

Prussia 1869–72	Actual numbers			Per cent.	
	M.	F.	Total	M.	F.
Very painful diseases	65	21	86	13	12
Slow, chronic „	107	47	154	22	27
Incurable, desperate diseases	121	38	159	24	22
Undetermined kinds	206	66	272	41	39

It is worthy of note how uniform the proportions of the two sexes are, and how the prolonged and incurable affections are even less supportable than the painful ones.[1] Even the loss of one of the senses by taking away a means of communicating with the external world predisposes to melancholia and suicide. In Prussia, in 1869–72, there occurred 20 suicides of blind people (17 men and 3 women), and 1 of a deaf-mute woman; and as according to the census of 1871, there would be 22,978 blind in Prussia, that would give the probable annual loss of **216** per million, whilst for the whole population it is only **133.** Acute and habitual alcoholism may be added to the physical causes, because of the known disorders produced by alcohol on the nutrition of the whole constitution. The relations between alcoholism and suicide have been shown by so many up to this time, beginning with Magus Huss down to Lunier, Fazio, and Baer, that we believe it to be hardly necessary to insist on the general import of the statistical figures. The number of violent deaths in France is, according to the works of Lunier ('Ann. Med. Psychol.,' 1872, 'Journal de la Soc. de Stat.' 1878), in direct ratio with the consumption of alcohol, nay, in several of the departments the increase of madness and suicide appears to attend that unhappy habit of 'civilized' peoples. The investigation of Lunier leads him over 79 departments, divided according to the quality and quantity of alcohol produced and consumed. The results of this enquiry are so important, and the figures have so eloquent a signifi-

[1] Out of 214 suicides in Paris through determinate physical disease were found: phthisis and affections of the chest 27; injuries to the sight 19; cancer 19; paralysis 17; diseases of the stomach 13; cephalalgia 15; venereal diseases 14; diseases of the urinary passages 13; of the heart and great vessels 19; epilepsy 6; gout 6; loss of strength 6; all the other affections (intestinal, cutaneous, scrofulous, hepatic, brain, infectious, hæmorrhoidal), from 5 to 1 (Brierre de Boismont).

cance, that we think it worth summing them up in a synopsis, giving warning that we unite, for want of space, the consumption of wine and cider.

Influence of the Consumption of Alcohols on Suicide in France.

Departments	Annual consumption in litres per inhabitants				Alcoholic frenzy per cent.		Suicides per million inhabitants	
	Wine and cider		Alcohols					
	1849	1869	1849	1869	1856–58	1867–69	1849–50	1868–69
I.—Departments which have no vintage or but little.								
a. 1st Group (3) . .	10·12	11·57	3·46	5·88	5·68	11·31	105·6	154·8
b. 2nd " (2) . .	57·20	64·80	5·47	8·48	16·69	21·89	161·0	253·7
c. 3rd " (11) . .	77·24	84·42	2·43	4·08	10·47	13·61	85·9	185·4
d. 4th " (5) . .	80·37	126·23	1·49	2·69	7·37	10·25	144·2	145 3
II.—Departments which produce wine and alcohol.								
e. 1st Group (18) . .	59·64	93·43	0·53	1·00	7·63	11·40	88·2	111·6
f. 2nd " (9) . .	80·35	91·46	1·25	1·94	7·92	12·25	120·0	173·4
III.—Departments which produce wine and cider, but little or no alcohol.								
g. 1st Group (2) . .	51·87	67·48	1·75	3·92	11·22	15·53	103·8	142·4
h. 2nd " (29) . .	62·12	72 97	0 69	1·30	6·04	10·02	74·5	107·9

It seems that the abuse of alcohol is more hurtful than that of wine, and that the alcohol of cider is more hurtful than that of the grape, beetroot, or barley, since in the north, where suicide and alcoholic frenzy prevail, the use of spirit and the fermented juice of apples is the most common. The Seine (included in group 4, series 1) is the department where most alcohol is consumed (in 1869, 9·38 litres of alcohol per head, and almost 300 of wine !), and has also the heaviest returns of violent deaths (447 in 1849–50, 370 in 1868–69). Let it be noted, then, that in those departments where the abuse of alcohol increases the most, there also has the alcoholic frenzy amongst women increased alarmingly (departments Aveyron, Allier, and Haute-Garonne), in opposition to those in which the habit increases in a less degree (Loiret, Hautes-Alpes, Aube, Rhône, Isère, &c.) Lunier was besides able to

show that in 1878 the number of suicides through alcoholism increases every year in France; in 1849 they were scarcely 6·69 per cent., but twenty years after they rose to double that number, 12·98, and in the five years 1872–76 the proportions were 11·6; 10·5; 10·1; 10·3; 13·4 per cent.

These facts are confirmed everywhere where alcohol or beer is consumed in excess—in the United States, in England, Ireland, Scandinavia, Russia and Germany, and in the Netherlands. It may be seen in our Table XXXVI., where the category of 'vices' includes specially acute or chronic drunkards, what part this habit plays with regard to suicide in various countries. And the numbers would be increased if it were possible to diminish the category of the 'unknown.' In Germany, according to Böttcher, 56 per cent. are owing to the use of alcohols. Denmark, which pays one of the heaviest tributes to suicide, consumes as much as 16 litres of alcohol each year per head (Fürste). Sweden has for long been the classic ground of alcoholism, and before the last restrictive laws also for suicides owing to that cause; in fact, up to 1845 the proportion was 46·6 per cent., in 1846–50 it rose to 62·2, and in 1851–55 to 65·5 per cent., but fell in 1856–60, on account of the severity of the Government measures, to 18·2, and in 1861–64 to 11·2 (Baer, *Der Alkoholismus*, ecc. Berlin, 1878). In England the annual consumption of alcohol, on the contrary, rose from 4·12 litres per head in 1825 to 9·07 in 1871, so that Brown found that 13·7 per cent. of suicides accrued from alcoholism (*on Intemperance and Insanity*, second part, pp. 6–7). In Italy, where the great quantity of wine is fortunately balanced by the small production and consumption of alcohol, there were only 90 suicides through alcoholism in twelve years (about 1·10 amongst men and 0·16 per cent. amongst

women). It is certain that a portion of these deaths is due to alcoholic frenzy, which especially arises from the use of the worst brandy of commerce, and which is marked by a depressed condition of the mental faculties, by terrible hallucinations, disorder and convulsive spasms, and hence the strongest impulses to homicide and suicide. It should be noted that the contingent of mad people through drink is greater in Italy than that of suicides through the same cause; it is 3·01 among men and only 0·34 among women; 1·76 in the aggregate (Verga).

A progressive sequence from the physical to the moral causes is given by heredity and by the constitutions which undoubtedly accompany a morbid condition of the brain. Heredity figures many times as the beginning of all psychical degenerations, and as to suicide it was demonstrated experimentally by Esquirol, Cazauvieilh, Falret, Lucas, Moreau, Doutrebente, and a host of others. In the Bavarian statistics, which alone take notice of this, inheritance appeared during 1857–66 in about 13 per cent. of known cases, and then reached 18 per cent. in 1866; but it is well known how difficult it is to gather up the exact remembrances of very many people, wherefore this proportion is much below the truth.

The suicides committed in the state of pregnancy or after child-birth, often accompanied by infanticide, are not rare among women; in Italy and Prussia they reckon 22 per thousand, in France 29, in Norway 50. The greater number concern girls seduced and then abandoned, whose responsibility in criminal acts is doubtful, according to the mad doctors of the somatic school. In the anæmic condition, in which the uterine functions place them, woman shows a great propensity to psychical disturbances on account of diminished energy of character and hyperæsthesia of the nerves, and with regard to hysterical suicides

they are rather diseased in mind than sane. If to such organic conditions we add the fear of dishonour, shame, grief at being betrayed and desperation at desertion, we have an aggregate of moral influences which act with morbid excitement on the brain, and often take away all responsibility of action.

The relation between suicide and the morbid condition of the brain is also well demonstrated by the results of the autopsy of suicides. The nature of this work prevents us speaking at length on this subject, although we wish to mention how Esquirol and Forbes-Winslow many years since made statistics of the wounds met with in the autopsy of suicides, and they found them both frequent and serious. In Würtemberg during 1873–75 they examined 594 dead bodies and they found: lesions of the brain and its envelopes 265 times, that is 45 per cent.; lesions in other organs 98 times, 16 per cent.; negative result 231 times, that is 39 per cent. Amongst the diseases of the brain those which predominated were chronic meningitis, the adherence of the membrane to the grey substance, atheroma of the arteries, varicose veins and intra-cranial exostoses; and amongst those of the other organs in the foremost place the abnormal positions of the intestines and the stomach, so frequently found among those suffering from mental alienation, tumours in the abdomen, degeneracy of the liver; in the second place genital urinary diseases, and especially of the ovarian cells, hydatids of the kidneys, Bright's disease, hypertrophy of the prostate, restrictions of the urethra, and lastly, heart disease and aneurism.

The English statistics of the causes of death kept with such exactness by Farr show the affinity of suicide with nervous diseases in another way, that is, by the surprising stability of the annual tribute paid by the population to

each of the diseases. In fact, the following are the averages *per million* inhabitants for the ten years 1867–76 and for the chief affections of the nervous system:

Years	Suicide	Cephalalgia	Apoplexy	Paralysis	Madness	Chorea	Epilepsy	Convulsions	Other cerebral diseases
1867	62	199	490	509	30	2	109	1,239	267
1868	70	207	494	501	31	3	110	1,206	250
1869	73	214	509	504	33	5	117	1,199	254
1870	70	222	521	523	39	4	117	1,192	249
1871	66	213	509	519	43	3	109	1,121	248
1872	66	221	515	507	35	2	116	1,109	238
1873	65	2[illegible]0	527	546	37	2	118	1,131	247
1874	67	246	547	535	39	3	110	1,156	261
1875	67	287	559	540	42	4	124	1,095	299
1876	73	281	518	497	39	5	115	1,052	269

There does not seem to us now to be any necessity to demonstrate the signification of these numbers to the reader of this work.[1]

Connected likewise with the causes of the 'physical' class is another which approximates to the moral causes, namely, misery, with all its horrible and shameful consequences. No nation is exempt from this unfortunate calamity, but Italy appears to have the sad pre-eminence, although its statistics do not note those who die of hunger. The economical conditions of the country undoubtedly have influence in this matter: in the years of agricultural distress

[1] On the other hand, it may be observed that the fatal tendency of brain diseases increases in England *with age*, as does also the readiness to commit suicide. Out of a million of different living beings in four groups of ages, there were in London during the decennial 1861–70 these proportions in the mortality:

	25–35 years of age		35–45		45–55		55–65	
	M.	F.	M.	F.	M.	F.	M.	F.
General mortality . . .	10,850	8,798	17,142	12,844	25,682	18,518	43.848	33,450
Deaths by suicide . . .	140	51	239	88	357	104	474	90
Death from disease of the brain	733	483	1,551	1,011	2,897	2,107	6,525	4,840

(for example, in 1870–74), the suicides increased through misery equally with those caused by pellagra. Want and pellagra then are sisters, since it seems to us that the exclusive opinion of those who ascribe this latter solely to the consumption of spoilt maize (Lombroso) is not beyond criticism; they forget that the cause of it, certainly consisting in the terrible indigence of the proletariat population of the country, is much more complex (Bonfigli).

And now we have arrived at suicides accruing from the excitement or depression of the sensitive faculties: as domestic troubles, deluded ambition, fear of punishment and dishonour; or from the most exalted passions, love and its morbid exaggeration, that is to say, jealousy; we have arrived in short at the manifestations of pitiless egoism.

It is a strange idea which we find expressed by Ferrus and Despine on the nature of the passions which drive men on to suicide. They admit that in men of sound reason suicide is most often determined by noble and generous sentiments; but this is inaccurate. The epochs and the nations in which suicidal frenzy is developed are really those, as Ferrus says, with an advanced civilization, the greatest political power, the highest psychical aspirations, but against the egoistical motives of crimes of blood we cannot, as is maintained by Despine, set an imaginary moral superiority in suicide. The more closely the determining causes of it are investigated, the more does it appear to be induced by a subtle egoistical sentiment. History proves this by enumerating and commenting with pride upon the very few and now traditional cases of voluntary death for love of country or philosophical fanaticism of a Cato, a Seneca, and a Pætus. But is it really certain that at the root of these murders and under the splendid appearance with which Greco-Roman classicism has known how to invest every little action of those ancients for our

degenerate posterity, is it really proved that we are to exclude from the motives the love of the 'I'? The causes of a political and religious order represent, according to the before cited psychologists, the height of the dignity and nobility of human aspirations; but how many of these are there in comparison with the overwhelming number ascribable to ambition, vices, cowardice, and vulgar prejudice?

Human nature is also imperfect even when it attempts to raise itself above its own nature. In every case the suicide of those is to be praised who, struck down by misery or wearied by the passion of gaming, would not seek the satisfaction of their wishes in the possessions or blood of others; but it is necessary to enquire whether this act was determined upon from respect to social laws or rather from weariness of present sufferings and from fear of those of the future. And what else are moral necessities but a psychical transformation of those which are at the root physiological? The evolution of the intellectual faculties has induced sexual love, the egoistical principle of utility, the instinct of the preservation and perfection of the 'I,' the desire to set aside the nutritive and sensitive propensities, so as to detach them, so to speak, from the animal frame, ennobling them with the character of superior needs belonging to man exclusively. Saint Marc Girardin thinks, although he expresses himself in other words, that man would never have contemplated self-destruction if the developement of the cerebral faculties had not added to his sufferings the torment of thought. It is not the nobility or elevation of motives which can make suicide appear to us as though always caused by generous sentiments, it is, on the contrary, because we are accustomed to consider the secondary effects and the modality rather than the spirit of things. The metaphysician and the moralist are always surprised at the aspect of human thought which 'reflects

itself in itself,' and do not perceive that under the heap of ideas organic necessities are always the only foundation of human action. How much has not the man of higher race ennobled love, raising it even to the high summit to which the imagination of Shakspere, Dante, Goethe, and of Milton reached! Yet who would deny that the sentiment by which the hearts of these heroes of thought beat was not produced by almost unconscious evolutions in the series of human phases, by that same instinct by which the Australian who steals and violates his woman in the forest, and the Hottentot disfigures her in the external generative organs? It is mournful and sad for those who think metaphysically of the kingdom of man to admit this transformation and the existence of human characters which cannot be reduced to biological laws; but for those who observe with the calmness given by the knowledge of truth it is also a point of comfort and pride to confirm the base origin of what now forms the most precious characteristic of the superiority of man.

We do not deny that there are suicides from elevated and generous causes, but they are excessively rare. We will pass over historical facts for two reasons; first because, coloured by the splendour of the Zenonian stoicism, they are traditional, and transmitted to us without the counterproof of a conscientious examination, and without that psychological data which nevertheless we consider necessary in these days to estimate properly the smallest moral action. The second reason is that, even if we accept the nature of the causes indicated by historian's of the time (political aims or offences against self-love), yet we do not recognise any great moral superiority in them. In fact, how can that voluntary death be called moral which, anticipating a future danger, shows fear and want of sufficient energy to await it, and when, in place of fighting,

the battle-field is abandoned by the deserter? That this kind of suicide is not the kind depicted for us is proved by the fact that, notwithstanding the progress of morals and civilization, it is practised by no one and in no country. We certainly find in modern times political suicides caused by the French Revolution, when the guillotine became an instrument of voluntary death for those who, deprived by the Terror of some friend, hastened by self-denunciation to follow on the same course (Des Étangs). But here the extraordinary excitement of the sensitive faculties which always accompanies great political actions enters the field; these are morbid exaggerations of opinions, which as they must be included amongst the acts of so called fanaticism, clearly fall within the dominion of mental pathology. There is only one contingency in which it may be said that the criminal or mad action is suggested by a noble feeling, and that is, when man sacrifices life for the good of his fellow-creatures, notwithstanding the repugnance he feels to die. But rare are the occasions on which man shows such disinterestedness.

We have here to speak of suicide, not of sacrifice of life nor of courage; only too mournful and defiled is that page of human history which we have to turn. In our days suicide is the effect of egoism, of unsatisfied passions, and we are obliged to make more of pathology than of morals. Let us hasten, however, to say that the higher part of ourselves does not fail to reveal itself even in individual motives for suicide, but this part is most of all the feminine. Not seldom is woman moved to throw away her own existence from sentiments and affections which suffice to ennoble vile and egoistical human nature; and it must be so, because it is natural that she who pays to affection the precious tribute of her own life, who for the

well-being of her children and those dear to her knows so often how to offer the even greater tribute of supporting the weight of existence. In man the manifestation of personal interests rules in every case, and as only a fourth or fifth of the suicides are committed by women, the already small proportion of those which are due to noble and generous motives becomes still more attenuated.

All the sufferings through which one seeks to leave life prematurely are negative. Psychology, thanks to Spencer, Bain, and Dumont seeking to solve the scientific question of pleasure and pain, has decided that pain is always due to a diminution of energy, which may depend upon an augmentation of expenditure and activity (*called positive*), or by a suppression of excitement, reparation and reaction (*called negative*). The last category is the most numerous and natural, nay positive pain may likewise be resolved into it, because the excess of activity brings as its consequence an exaggerated expenditure and diminution of energy (Dumont). On account of our reluctance to adopt dialectics in scientific investigations, it seems that the psychological theory is reduced to the physiological one already mentioned; namely, that suffering is always the effect of the want of satisfaction of our needs, whether nutritive, sensitive and reproductive, or cerebral. Man judges that suffering when it specially arises from a negative diminution of his own energy, from an unsatisfied desire, gives him a right to take his life; and since the moral importance corresponds to the intensity of the want assigned to it by man, it is when the desire attains to the level of a passion that the suffering throws the mind into a state of disorder, and causes the momentary pain of death to appear less hard than the lasting consciousness of loss or of the awakening from illusions. In fact, if that state of general instigation

which is called impassioned enters into every unsatisfied desire (suffering), every living force of which man can dispose takes part also in it, and the chief of them belong to the intellectual, to which civilization has given such co-ordinate influence that no act can be fulfilled without the corresponding expenditure of cerebral energy. In all cases of suicide, whether they happen after weighing motives and consequences, or are the effect of a sudden resolution, emotion is necessary, that is to say, suffering or cellular automatism must have thrown the brain into abnormal excitement. *Tædium vitæ* is a suffering, even the characteristic negative suffering of privileged races and classes, among whom there are suicides even in the midst of all the gifts of fortune, and apparently without any cause of suffering, so that those who are wearied would appear to wish to fly from the monotony of existence by artificially exciting their own sensibilities. But is it possible to believe seriously in the declaration of coldness and indifference in the face of death left in writing by these suicides? It is certain that moralists and De Boismont himself give this too much weight, and as it is not to us an irrefutable proof of soundness of mind, neither is it proof sufficient that in the suicide of the cynic or sceptic the emotional element, suffering, is wanting. Of that ostentatious coolness there remains a lying and proud written evidence, but who can know what a struggle that moment of passing resolution cost the hand by which those few lines were traced? And do we not see morbid conditions of the mind, delirium of the understanding, disordered passions, march together with the most inflexible calmness, with the firmest resolution, and the most subtle logic?

Seeing, then, that the anguish produced by the false expenditure of functional energy (unsatisfied desires)

corresponds with the aggregate of suffering (passion) which ends in madness, ecstasy, despair, and hence in suicide, so in pain caused by offended self-love or by wounded affections, the necessity of the resolve taken is evident. It is maintained that suicides through shame, modesty, remorse, offended dignity, are noble and generous acts, but is it not clear on the contrary that the suicide wishes to spare himself the unhappy consequences of his own position, and he thinks to interest in his memory those whose derision and contempt he had to fear while living? Suicide was therefore selfishly necessary for him.

But let us consider lastly how the series of determining causes are resolved into one only, to despair at not having gained or at having lost that which, in the emotional condition of passion, was valued more than life. For if in the actual conditions of associated life suicides increase, it is because with so many and so overwhelming wants which multiply and extend every day, human egoism has more frequent opportunities for displaying itself. And, indeed, it shows itself in everything, beginning with love, that emotional condition which gives the greatest pleasure to most men, but sometimes also the greatest pain. Whether it concerns an opposed affection or the desertion of the beloved one, it is in each case a powerful want which desires to be satisfied; nor is it possible to understand the suicidal frenzy in a case where affection should take the tranquil and ideal paths of platonism, because among suicides of this kind it is not the happiness of others which they have at heart, but their own. And this is the case even in those caused by the egoistical transformation of love into jealousy, which so often disorders the mind and leads to criminal actions, or to the most serious mental alienation.

Injured affections, sufferings of the heart, are the

domestic troubles whose influence on suicide is among the most powerful—arising from ill-assorted marriages, from family discord, often from misery which irritates the temper, and is sufficient to extinguish every feeling of affection during the cruel trial which by means of privation it causes individual egoism to endure. Nor do ingratitude and indifference to relations fail to appear, nor the aversion awakened against people newly introduced into the family by marriage; nor is the now common pretext of 'incompatibility of temper,' under which lurks either a hankering after new sensual gratification or satiety of the old, destitute of foundation. Very many families have the germs of misfortune within themselves, based as they are upon ties thoughtlessly contracted, or formed with the usual improvidence of the middle classes, and all the more easily are these germs developed and matured when the ground is prepared for them by inheritance, alcoholism, passion, and libertinism.

And are not suicides through egoism those of over-thrown ambitions, of speculators baffled in their hazardous enterprises, of those engaged in commerce and industries who have run the whole career from bad faith to downright dishonesty, from fraudulent crises to gradual collapse, or to violent death? It is useless here to insist upon this; it is modern civilization with its burning fever which, like Saturn in the fable, devours its own children. The supreme aim is the *excelsior* of vanity or of riches, but the road runs at the edge of the precipice, it grazes the keen edge of the criminal code, that his days may be ended at the door of an asylum or a prison, or the Morgue.

If there are suicides committed through fear of condemnation or from the desire to escape from a law process, from dishonour, from punishment, we must not flatter ourselves that they are dictated by a noble feeling. They

are the consequence of offended self-love, never from regret for having broken social laws; often they follow upon some serious crime, and they are not rarely those of monomaniacs. In any case can they be said to be exempt from egoism who are never free to choose between two evils, but of necessity incline to that which will cause them the least suffering? Dishonour, punishment, the remote probability of death by the hangman, exercise so painful an excitement and instinctive repugnance on the mind of man, as to determine him to choose as the lesser evil, death by his own hand; this deliberation, which in most cases evades the claims of society, is then the last sacrifice accomplished at the instigation of self-regard.

§ 3. *Influences which modify the nature of the motives.*

These influences are the same which are exercised on the general movement of suicides; namely, climatic and meteorological conditions, the degree of culture, sex, age, and profession. We will pass rapidly over the first, because the want of homogeneity of the statistics forbids our drawing precise deductions from them. Certain it is that whilst in the South passions, love and misery predominate; in the North alcoholism is the prevailing cause, and in the centre of Europe, where there is the highest culture, the chief causes are *tædium vitæ*, shame, and fear of punishment. Alienation of mind shows itself, as we have seen, in almost an equal degree, whatever climate is under consideration, whilst other causes, especially moral, vary according to the degree and particular kind of civilization. Thus where the domestic ties are closest and strongest, and where the man can find assured repose in the family in the struggles of life, as in Germany and Scandinavia, suicide

from domestic troubles is rare, whilst they increase in Catholic countries (Belgium, France, and Italy) on account of the lesser part taken by family affection in individual life.

The influence of season was considered by us when speaking of madness relatively to the months, and as for causes of a moral nature it would seem that destitution and domestic troubles especially cause most suicides in the warm months in Italy.

Of the social influences, that of religion deserves to be mentioned. The only Prussian statistics of 1871–72, although incomplete, were able to decide the causes of 1,622 suicides classed according to religion and sex. We give the proportions per 1000 for each principal category of motives.

The Influence of Religion on the Causes of Suicides in Prussia, 1871-72.

	Protestants		Catholics		Jews	
	M.	F.	M.	F.	M.	F.
Number of known cases	1,160	208	205	38	8	3
Per 1,000						
I. Mental diseases	282	538	380	631	375	1,000
II. Physical diseases	96	77	59	105	--	—
III. Weariness of life	141	87	122	79	125	—
IV. Passions	35	58	29	53	125	—
V. Vices	118	24	127	53	250	—
VI. Suffering and affliction of all kinds	168	87	127	26	—	—
VII. Remorse, shame, and fear of punishment	138	120	127	53	125	—
VIII. Other causes	22	9	29	—	—	—
Total	1,000	1,000	1,000	1,000	1,000	1,000

In these few figures the Catholics (and the Jews) show themselves most inclined towards suicide through madness and vices, whilst Protestants yield the greater number to the passions, domestic troubles, financial disorders, remorse and shame, and to weariness of life, which agrees as to the first with their usual tendency to delinquency and to religious fanaticism; and as to the second, with their

high culture and greater morality. But, as is easily understood, much more evident are the differences which depend on individual conditions, and principally on sex and age.

The sexual differences (Table XXXVIII.) are owing, beyond the diverse physical and psychical constitutions of the two sexes, much more to the different system of life, to education, culture, and habits. Thus suicides occasioned by madness, delirium, pellagra and frenzy, preponderate in the feminine sex (see Table XXIII.), so much that in some countries, as in Italy, women offer a proportion double that of men; and in France out of 30,000 cases investigated by Guerry the average of the mad was 33·2 per cent., whilst among men only 29·1 and among the women 46·8 per cent. Besides, this special feminine priority is explained by the fact that the tribute paid by madness by the two sexes approaches much more nearly than that of the suicides. With regard to the types of alienation, the greatest difference is in pellagra in Italy, which is most frequent amongst women, about five per cent.; the other forms, even taking count of the undetermined, vary still less.

Table XXXVIII.—*Influence of Sex on the Determining Motives for Suicide.*

Per Hundred Suicides of Women and Men (*See* Table XXIII.)

Presumed Causes	Sweden 1852–55	Norway 1856–70	Prussia 1869–75	Saxony 1847–76	Würtemberg 1846–50	France 1866–75	Italy 1866–77
I. Mental diseases	371	190	233	217	520	241	217
II. Physical diseases	250	—	335	2[illegible]	437	428	310
III. Weariness of life	0 w.	256	610	739	(443)	606	1,500
IV. Passions	200	261	161	208	233	152	208
V. Vices	1,563	4,233	2,081	1,728	—	1,053	3,100
VI. Domestic troubles	183	210	359	275	453	335	354
VII. Financial disorders	954	1,109	1,633	7,271	294	1,445	2,261
VIII. Misery			916	898		530	598
IX. Remorse, shame, &c.	289	293	347	412	169	488	498
X. Despair.—Unknown	1,040	316	688	643	(757)	563	314
Total average	455	320	408	389	440	397	346

As to other causes (physical and moral) the greatest excess of men is found in the group of vices, in that of financial embarrassments, and in weariness of life, that is to say, amongst the egoistical motives, whilst among women, after mental diseases, there predominate passions, domestic troubles, shame and remorse (especially in cases of illegitimate pregnancy). Among the causes which urge them to leave this life woman always exhibits that spirit of self-denial, that delicacy of feeling and of love, which inspire all her acts.

There is a group of causes where the feminine moral superiority becomes still more evident, and these are in the loss of husband and children, in the desertion of relations, in short in the least selfish feelings. Love also preponderates in woman, above all in Italy, Emilia, though in a less degree, being included; which last fact we note as contradicting the common idea that the intensity of this passion is greatest in the southern portion of the kingdom.

On the other hand, the prevalent supposition that the juvenile age would stand first among the number of suicides caused by love, jealousy, or illegitimate pregnancy, is confirmed by Italian and Prussian statistics (Table XXXIX. on the Influence of Age), the returns of which are in wonderful agreement. In the adult age the influences of financial embarrassments and of mental diseases are more felt, because as years increase so at the same time the passions are calmed, and man finds himself immersed in practical questions of existence; until in advanced years the weariness of living hastens death, both by will and deed (in Prussia, for in Italy suicides through *tædium vitæ* show no regularity).

The causes which lead children to commit suicide deserve attentive examination. They are like the painful

TABLE XXXIX.—*Influence of Age on the Causes of Suicide in Italy and Prussia.*

(Proportions per 1,000 *on the Actual Number at each Age.)*

AGE AND SEX	Number of cases per age	Mental diseases	Physical diseases	Weakness of life	Passions	Vices	Domestic troubles	Financial disasters and misery	Shame. Fear of punishment	Unknown or undetermined
ITALY (1868–77)										
A.—MEN										
Under 15 years . .	36	138	—	28	—	28	250	28	—	528
From 15 to 20 years .	325	74	34	55	99	6	166	56	68	442
,, 20 ,, 25 ,, .	796	101	45	88	138	6	83	92	60	387
,, 25 ,, 30 ,, .	725	144	51	47	114	6	7[illegible]	135	55	378
,, 30 ,, 40 ,, .	1,191	233	75	23	42	8	77	180	34	328
,, 40 ,, 50 ,, .	1,393	268	51	22	17	13	75	273	26	255
,, 50 ,, 60 ,, .	1,347	206	62	19	7	17	73	269	20	237
,, 60 ,, 70 ,, .	928	308	82	26	7	11	59	269	16	222
,, 70 ,, 80 ,, .	298	363	84	50	—	3	57	235	13	195
,, 80 and upwards	56	321	125	18	—	—	53	268	17	198
Age unknown . .	78	103	38	26	—	—	38	167	—	628
B.—WOMEN										
Under 15 years . .	10	300	—	—	200	—	300	—	—	200
From 15 to 20 years .	135	104	22	22	297	—	13	22	74	326
,, 20 ,, 25 ,, .	220	205	27	14	259	—	95	32	73	295
,, 25 ,, 30 ,, .	179	262	89	6	168	6	101	55	73	240
,, 30 ,, 40 ,, .	325	489	71	6	43	—	108	71	15	197
,, 40 ,, 50 ,, .	345	510	84	6	18	2	69	90	9	212
,, 50 ,, 60 ,, .	318	562	78	7	3	—	72	83	—	195
,, 60 ,, 70 ,, .	206	563	92	5	—	—	58	122	—	160
,, 70 ,, 80 ,, .	58	448	104	34	—	—	18	104	17	275
,, 80 and upwards	24	416	125	—	—	—	42	167	—	250
Age unknown . .	13	385	—	77	77	—	77	77	77	250
PRUSSIA (1869–72)										
A.—MEN										
Under 15 years . .	120	117	—	25	42	8	67	8	300	433
From 15 to 20 years .	523	224	17	36	42	30	76	42	224	309
,, 20 ,, 25 ,, .	974	212	32	35	65	36	54	54	242	270
,, 25 ,, 30 ,, .	763	245	57	85	58	68	34	98	125	230
,, 30 ,, 40 ,, .	1,433	329	40	73	32	102	26	120	108	170
,, 40 ,, 50 ,, .	1,776	327	56	100	8	138	20	138	81	132
,, 50 ,, 60 ,, .	1,872	318	62	149	4	150	22	123	63	109
,, 60 ,, 70 ,, .	1,229	242	70	217	3	90	15	99	56	108
,, 70 ,, 80 ,, .	429	300	90	291	—	60	10	97	39	113
,, 80 and upwards	74	299	121	365	—	40	—	27	13	135
Age unknown . .	253	128	27	81	27	62	3	77	32	563
B.—WOMEN										
Under 15 years . .	22	91	45	—	—	—	45	91	409	319
From 15 to 20 years .	232	262	21	35	106	17	120	24	277	138
,, 20 ,, 25 ,, .	268	261	33	41	164	8	46	41	242	164
,, 25 ,, 30 ,, .	240	434	50	29	95	—	29	58	170	135
,, 30 ,, 40 ,, .	370	546	73	43	32	16	51	80	76	83
,, 40 ,, 50 ,, .	416	570	84	57	12	32	23	79	66	77
,, 50 ,, 60 ,, .	391	560	125	76	2	48	13	65	56	55
,, 60 ,, 70 ,, .	267	636	82	119	—	26	3	48	11	75
,, 70 ,, 80 ,, .	117	521	85	289	—	17	8	40	17	73
,, 80 and upwards	29	374	34	413	—	—	—	103	—	76
Age unknown . .	20	450	50	50	50	50	—	—	50	300

emotional susceptibility of adults, in proportion to the quality of their intelligence and their condition of life. Those who think that adolescents are urged on to this act by frivolous causes, err in the sense that these causes make as much impression on the mind, and excite the brain matter of a child as much as a strong passion in the case of a young man, or a chronic malady of an old one. The education which is now given to children assists the precocious developement of the reflective faculties, of vanity, and of the desires. It is true that the present method of teaching by abolishing brutal repressive means, intimidation, and threats, has removed one powerful cause of suicide of children (Ferrey, Collineau), but it appears that with the modern habits of life other influences grow in force, and puberty beyond all others, for it usually produces, along with power in the reproductive organs, changes in temper also, exaggerated sensibility, and a dominance of the new affections sufficient to silence the instinct of preservation.

Examining, then, the particular causes in the two sexes, we find that in man the proportions of mental diseases, of vices, and financial embarrassments, increase up to maturity and the commencement of old age (from 40 to 60 years of age), and then diminish in the state of decrepitude:—that physical diseases are regularly progressive from youth to late age:—that the passions, affliction for loss of relations, domestic troubles, professional failures, prevail by far the most in youth, particularly before 30 years of age:—highest of all under the age of 25 is the proportion of suicides through shame, remorse, and fear of punishment, or after crimes committed, while they decrease gradually as age increases. Let it be also noted that the average of weariness of life would be still higher among old people (Prussia) if we deducted the

suicides of soldiers (between the ages of 20 and 30) from disgust of military service.

Also amongst women the proportions of mental disorders increase up to the age of 70 and decrease in decrepitude. There is also a difference as to physical diseases, whose share augments regularly amongst men from the first to the last period of life, whilst among women it diminishes after the age of 60. The passions and domestic troubles are more sharply felt by woman in her youth, weariness of life in old age: vices such as drunkenness and debauchery are peculiar to women between the ages of 40 and 60; whilst the largest proportion of suicides through shame (chiefly illegitimate pregnancy) belongs to the young women under the age of 20, least able to resist seduction.

On distinct causes, according to the Registrar's returns (Table XL.), the numbers have, as might be anticipated, a high psychological meaning. In celibacy, men, beyond the harm through madness common to all ages and conditions, encounter grave dangers from remorse and fear of punishment, afterwards from weariness of existence, and women from shame of hidden pregnancy, from love and domestic troubles. In the conjugal state readiness to commit suicide through madness augments especially among women; amongst men financial embarrassments and weariness of life take the place of remorse, and vices replace the passions. The married woman shows a singular susceptibility to physical diseases, and naturally to family troubles or dissensions. The widowed of both sexes, besides a heavy proportion of suicides through madness, display a large number also through weariness of life, whilst vices acquire their highest influence amongst the divorced (Prussia), although they are powerful also in widowhood. Amongst divorced women the average

TABLE XL.—*Influence of the Civil Status on the Causes of Suicide in Italy and Prussia.*
(*Proportions per* 1,000 *on the Actual Numbers of each Registrar's Returns.*)

Causes	Unmarried		Married		Widowed		Divorced		Unknown	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
ITALY (1872–77)										
I. Mental disorders	162	268	266	497	303	472	—	—	143	143
II. Physical diseases	59	59	74	89	59	60	—	—	53	—
III. Weariness of life	55	12	16	—	28	14	—	—	—	—
IV. Passions	77	199	7	10	21	14	—	—	—	—
V. Vices	8	—	11	2	9	—	—	—	—	—
VI. Domestic troubles	77	103	83	87	56	70	—	—	45	143
VII. Financial disasters	86	12	186	33	130	37	—	—	143	—
VIII. Misery	49	20	97	52	189	106	—	—	53	143
IX. Shame-fear of punishment	43	64	25	26	30	5	—	—	7	—
X. Diverse and not stated	384	263	235	204	225	222	—	—	556	571
PRUSSIA (1869–72)										
I. Mental disorders	278	330	304	589	302	569	209	393	88	400
II. Physical diseases	46	40	58	93	69	84	28	153	18	—
III. Weariness of life	81	49	117	55	224	147	209	30	65	133
IV. Passions	50	117	6	8	4	—	17	91	3	—
V. Vices	55	13	106	27	112	29	208	30	36	—
VI. Afflictions	3	3	3	7	13	14	—	—	—	—
VII. Embarrassments and suffering	57	36	150	84	88	49	113	121	39	—
VIII. Domestic troubles	37	60	20	11	9	6	17	—	3	—
IX. Shame—fear of punishment	163	205	79	58	62	29	113	152	26	—
X. Diverse and not stated	230	147	157	68	117	73	86	30	727	467
Total	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Number of cases, Italy	2,089	407	2,010	565	538	216	—	—	133	7
" " Prussia	3,160	842	4,367	975	1,318	485	177	33	308	15

of suicides through shame becomes again higher, perhaps on account of new illegitimate pregnancy, and the humiliating position in which separation from the husband places women in certain social ranks.

It would be worth while to examine what share trade and social condition have in creating determining causes for suicide. The Italian, French, and Prussian statistics would give us an opportunity for so doing, but we shall make use only of the first, as being those which keep separate the categories of professions in the most rational

way. The following are the numbers per 1,000 of the presumptive causes, according to the principal professional groups (see ch. V., § 4), calculated on the six years 1872–77.

Table XLI.—*Influence of the Professions on the Causes of Suicide in Italy during* 1872–77.

(*Proportions per* 1,000 *on the Actual Numbers of each Professional Category.*)

Presumed Causes			anc rts				pl.			
A.—Men										
Number of cases	1,073				409	591	493		147	113
I. Mental disorders	458	154	133		64	159	227	181	177	71
II. Physical diseases	71	66	71		34	71	97	42	41	18
III. Weariness of life	17	22	20		134	27	41	16		18
IV. Passions	21	41			71	39	42	22		53
V. Vices (drunkenness)	5	16			5	5			14	—
VI. Domestic troubles	57	82	53	95	56	90	124		75	62
VII. Financial troubles	58	152	275	112	64	218	175	37	—	62
VIII. Misery	92	122	73	35		34	31	228	190	70
IX. Shame—fear of punishment	20	28	18	43			30	27	14	9
X. Diverse and unknown	201	317	317	431	504	298	225	330	340	637
B.—Women										
Number of cases	449	210					104	40	277	
I. Mental disorders	581	367					385	225	297	454
II. Physical diseases		67					67	100	101	
III. Weariness of life						91	10	—	7	
IV. Passions						363	48	25	90	
V. Vices (drunkenness)		5								
VI. Domestic troubles		95		125		182	135	75		
VII. Financial troubles		48	77	28		91	48	25		
VIII. Misery		52		14		91	9	175		
IX. Shame—fear of punishment	13	33					19	75		
X. Diverse and unknown	163	219	461	347		91	279		282	364
Total	1,000	1,000			1,000	1,000	1,000			

First of all we always find a very marked sexual difference in the usual categories of causes, that is to say,

in mental alienation and the passions which preponderate in the feminine sex, in vices, financial embarrassments, and want, which are greatest in the male sex; the individual profession then does not appear to modify the influence of sex. But coming to a minute examination we find remarkable divergences even in particular professional groups. In both sexes the social class, which yields in the greatest numbers to the suicidal impulse through madness, is that which is devoted to the production of raw materials, that is, countrymen, shepherds, day labourers of the country, whilst a smaller number than all the others is given by suicides through love and weariness of life, financial embarrassments, and (speaking of well-defined professions) also through remorse and shame. Suicides through physical sufferings reach their maximum amongst the cultivated classes of society, whilst it seems the contrary ought to be the case, and those through drunkenness, on the other hand, are found amongst labouring people (porters, commissioners, day labourers), and amongst the operatives. Domestic troubles also are frequent in the highest classes, that is to say, amongst professionals and proprietors. With regard to suicides through money troubles and want, they are higher among the working classes, which is in agreement with the abuse of alcohol peculiar to that low class of society; then follow the superior ranks and tradespeople. The greatest inclination towards suicide through passion (love and jealousy) is found amongst the males in young students (dependent on others) and soldiers, and amongst women those who are schoolmistresses, teachers, and servants. It is also amongst women servants and labouring women that seduction and hidden pregnancy make most victims. The difference between the military and civilians with regard to *tædium vitæ* and fear of condemnation and of dis-

ciplinary punishment is noteworthy: thus in Austria (1851–57) the suicides amongst the military through these motives are more numerous than among civilians, whilst on the contrary, in Saxony (1847–58) and in Prussia (1869–75) those through remorse and fear of punishment and unfortunate love are more numerous.

It is seen from all this how much man in his actions depends upon the material and social atmosphere in which he lives, and how mistaken is the argument of those who pretend to justify suicide by the old Zenonian motto, '*Mori licet cui vivere non placet*,' by which our duties to society are silently passed over, and only individual interest admitted.

CHAPTER VII.

METHODS AND PLACES OF SUICIDE.

THE variety in the means for taking away one's life forms a characteristic of suicide as general and multiform as its average intensity, since the same influences which act on members of society to drive them on with more or less frequency, to voluntary death, also makes them incline rather to one instrument of destruction than to another. The localities where suicide is committed are as much varied; hence the necessity for giving in statistics a distinct place to the twofold study of means and places.

For whoever wishes to shorten the course of existence will certainly not lack means in his natural surroundings. Nevertheless, amidst so many surrounding elements and forces so hostile to us, the suicide does not easily fix upon the first means which occurs to him; sex, age, race, profession, climate, and the causes of the fatal act enter into this last deliberation; nay, as many are the laws according to which the general tendency and counter-tendency to suicide is shown, as are those which regulate its mode and place of execution. Yet if there is a human act which seems in apparent relation with a free choice, certainly it is the preference given to an instrument for self-destruction; but statistics do not leave us long in doubt, in an aggregate of men of whom the physiological and moral conditions are constantly equal, the nature and number of

means of death are always the same, their choice belonging to the general stability of social phenomena.

§ 1. *General Laws in the Choice of Means of Death.*

Guerry was the first to demonstrate the regularity of this choice out of a considerable number of cases, who justly compared it with the annual distribution of births, marriages, and crimes. First of all may be taken into consideration that the choice always falls by preference on the same means of destruction, so that, amidst such a variety of dispositions, they remain limited to the following principally: drowning, hanging, fire-arms, wounds, poisoning, falls from a height, and asphyxia. The cases of suicide by other means, such as starvation, crushing, bruising, purposely induced diseases and infection, striking the head, through crucifixion, by falling into the fire, setting fire to one's clothes, splitting the skull with dynamite, swallowing hard or pungent bodies, or the swallowing of boiling water or oil, or of great quantities of brandy, are exceptional and scarcely ever registered in statistics. Each country certainly has its particular predilections, but in the aggregate of the peoples by whom suicide is practised, the rope appears to be chosen before every other instrument, and immediately after that water (both giving $\frac{5}{10}$ to $\frac{8}{10}$ of cases); fire-arms follow, then those arms which cut or stab; falling from a height is preferred to charcoal and poison, and lastly come all the other means. From this it may be inferred that in the choice of the means of death man is generally guided by two motives, *the certainty of the event* and *the absence or shortness of suffering*. When suicide is accomplished by very painful means or at the cost of prolonged agony, in ninety-nine cases out of a hundred it may be assigned as

the act of a mind disordered by fanaticism, by madness, or by morbid excitement. The terrible wholesale suicides of the Oriental populations, suggested always by pathological exaggeration of the religious feeling, are, as Wagner notices, the opposite to those accomplished with indifference, sometimes with coquetry, by the cultured European. It is true that the habits and civilization of a people cause the choice of means to vary, by exercising a kind of fatal coercion on the individual, so that, for example, in Russia, where carrying arms is subject to severe laws, and where the cold climate obliges one living within doors for almost the whole year, the suicide hangs himself by preference, whilst in Italy the hurtful facility for possessing arms, perpetual serenity of the sky, and the high temperature, give opportunity for the most frequent suicides by means of the pistol or by drowning. Taking into consideration all the means chosen, the constant dependence of man on the nature of his surroundings is seen, even in the death which he procures for himself by violence.

One important statistical fact is that the choice is constantly the same from year to year in a limited group of men, by which the modifying influence exercised by external influences on the human will is made still more evident. We might bring forward a large series of data in support of this law, because it is especially in extended and uniform numbers, such as the French, Prussian, and Saxon, that it can be verified; nevertheless, we will limit ourselves (also for want of space) to the figures only of a decennial or a quinquennial. In our Table XLII. we give the proportions per thousand of the methods of destruction chosen by English, French, and Italian suicides during ten years, of Prussians for seven, and Bavarians for four: *the result would be the same even if the returns were for*

Table XLII.—*Regularity in the Choice of Means of Suicide.*
(Proportions per 1,000 without Distinction of Sex.)

Countries and Years	Hanging	Drowning	Gunshot wounds	Cutting and stabbing	Poison	Fall from height	Asphyxia	Railway	Otherwise
Italy[1]									
Year 1868	179·8	318·8	247·4	65·3	40·8	107·1	21·4	10·2	8·9
„ 1869	151·6	270·1	319·1	55·3	50·5	112·1	22·1	9·5	9·5
„ 1870	196·7	327·4	219·5	45·7	43·2	126·9	12·9	14·9	14·9
„ 1871	154·3	313·4	263·1	69·4	44·2	114·8	21·5	14·3	4·7
„ 1872	182·0	337·0	226·9	50·1	60·6	95·5	17·9	14·6	14·6
„ 1873	185·7	329·1	226·6	46·1	60·5	115·9	14·3	17·4	5·1
„ 1874	174·3	305·4	236·4	56·0	60·1	106·4	13·7	33·5	13·8
„ 1875	173·5	273·3	251·6	57·4	62·9	104·2	31·4	26·0	19·5
„ 1876	125·9	246·1	285·1	57·7	69·3	113·5	29·3	21·5	11·1
„ 1877	176·4	299·7	237·9	59·6	55·3	111·5	22·8	23·7	13·1
France									
Year 1866	445	283	103	42	19	34	64	10	
„ 1867	460	273	99	42	23	31	61	11	
„ 1868	453	271	105	40	23	17	80	5	6
„ 1869	459	272	97	44	22	31	65	4	6
„ 1870	485	277	114	40	17	29	29	5	4
„ 1871	443	285	132	34	16	31	48	5	6
„ 1872	426	269	103	71	20	28	69	8	6
„ 1873	430	298	106	37	21	30	67	6	5
„ 1874	440	269	122	36	23	28	72	6	4
„ 1875	446	294	107	83	19	31	63	4	3
Prussia									
Year 1869	599·7	213·7	100·1	36·5	32·3	6·6	3·1	6·0	2·0
„ 1870	621·2	189·7	95·9	44·3	37·6	7·1	4·8	6·4	3·0
„ 1871	628·3	182·5	101·4	43·6	21·0	6·6	3·3	12·2	1·1
„ 1872	610·7	197·2	102·5	41·3	25·7	6·9	3·0	10·9	1·8
„ 1873	597·0	217·0	94·9	37·0	25·4	8·4	4·6	14·2	1·5
„ 1874	610·7	162·6	126·5	33·8	28·0	9·1	6·5	21·8	1·0
„ 1875	615·4	170·2	105·8	34·8	35·1	9·5	7·7	19·5	2·2
England									
Year 1867	371	175	43	204	103	106			
„ 1868	377	193	66	188	92	32	—	16	36
„ 1869	386	184	45	212	90	19	—	20	44
„ 1870	375	191	49	200	97	25	—	22	41
„ 1871	367	212	42	201	88	30	—	23	37
„ 1872	374	221	38	194	91	30	—	18	32
„ 1873	366	218	44	200	97	20	—	16	39
„ 1874	374	176	58	214	94	20	—	16	48
„ 1875	362	208	45	226	97	62			
„ 1876	364	216	47	199	99	75			
Bavaria									
Year 1871	564	210	131	26	32	37			
„ 1872	544	189	169	32	30	36			
„ 1873	511	219	149	56	22	43			
„ 1874	514	201	155	36	26	38			

[1] The proportions of this table are calculated on the actual numbers registered in Table I.

fifty years, the truth of which is shown by the constant preservation through the longest periods of a preference given in a country to one fixed form of death. Thus in Italy drowning always takes the first place, along, however, with gunshot wounds, which in some years (two only) equal or exceed them; hanging always comes in the third place, and in the fourth falling from heights; wounds by cutting or stabbing and poisonings are so nearly equal that they contend for the fourth place through the same number of years; further removed but yet nearly equally, asphyxia by charcoal and crushing under a railway train are chosen. In France the order is still more regular and clear, the differences of the various methods of death being greater. They are in the following order: hanging, drowning, firearms, asphyxia, arms for cutting and stabbing, falls, poison, crushing by railway train. The Prussian and Bavarian returns serve us as an example for the countries where hanging much predominates; in both these German States the choice of means of death falls every year in the same order in which they are placed in the Table, from the first, which is the rope, to the last, which is asphyxia. As to England its series of figures is still more significant. From the important works published by Farr the annual proportion of suicides by each method of death per million inhabitants may be inferred, and so great is the uniformity and constancy of these proportions for the last twenty years (1858–76), that we think it opportune to collate them for the reader, and also because they prove better than any of our demonstrations the regularity of human actions.

In the midst, however, of the regularity of the general returns, some secondary phenomena of great significance are displayed. The first is the progressive increase of cases of hanging throughout almost the whole of Europe,

Regularity of the Choice of Methods of Destruction by Suicides in England.

Year	Annual average number of suicides per million inhabitants						
	Aggregate	Fire-arms	Cutting and stabbing	Poison	Drowning	Hanging	Otherwise
1858	66	3	13	6	10	30	4
1859	64	3	14	6	11	27	3
1860	70	3	14	8	11	27	3
1861	68	3	13	6	11	30	5
1862	65	3	11	6	10	30	5
1863	66	3	13	6	12	28	4
1864	64	3	12	7	10	27	5
1865	67	3	12	7	11	28	6
1866	64	3	13	6	10	25	7
1867	62	3	13	6	11	22	7
1868	70	5	13	6	14	26	6
1869	73	3	16	7	13	28	6
1870	70	3	14	7	14	26	6
1871	66	3	13	6	14	24	6
1872	66	2	13	6	14	25	5
1873	65	3	13	6	14	25	5
1874	67	4	15	6	12	25	6
1875	67	3	15	7	14	24	4
1876	73	3	15	7	16	26	6

only a few States being excluded. In France particularly, the rope is being substituted for other methods, as is verified in the figures of the last ten years, and as is seen still better in the proportional data of the two sexes (see *ante*). But similar increase in hanging is to be seen also in Sweden, Norway (up to 1865, then they cease), Denmark, Saxony, Bavaria, Baden, and England. There has been no increase in Würtemberg and Austria; in Italy and Prussia the choice of hanging is nearly stationary. In opposition to the increase in hanging, the suicides in France by drowning, and still more those by firearms, decrease. The method by asphyxia from charcoal, which was first peculiar to Paris, is now extending also to the departments, and even passes the French frontiers, so that in Prussia it gives signs of increasing every year. Another means, which seems constantly to augment, is the being run over by railway trains, as

the figures of Italy and Prussia bear witness, the which depends as much on the spirit of imitation, which has brought into use a rapid and sure means of death, as on the developement made in railways lately, which are always traversing new regions. The choice of poison increases sensibly in Saxony, Prussia, North America, and somewhat in Italy, whilst it decreases in Denmark and France, in proportion to the increase of hanging.

Other aspects of the regularity of moral phenomena are offered to us by the statistics of the means of destruction chosen by suicides, by distinguishing sometimes, as is done in England, the various kinds of poison used, or, as in Prussia and Saxony, the sort of wounds preferred. With respect to the first it is really worth noting the constant predilection which the English suicides show from year to year for the same poisonous substances, very rarely putting aside those most certain in their result, and less painful in effect. Observable also is the influence which the developement of the industrial arts has over the number and kind of suicides through poisoning, those poisons always being chosen by preference which are within easy reach of the suicide, so true is it that all classes of industrial workmen appear to have their predilection. In the meantime, in the aggregate of suicides which happened in England in 1863–74, the following poisons seem to have been always more used than any others: prussic acid, cyanide of potassium, laudanum, oxalic acid, arsenic, strychnine, the vermin killer, and oil of bitter almonds; whilst in the second and third places are always found caustic acids, mercury, preparations of opium and morphia, vegetable narcotics, phosphorus, and salts of copper. Lastly, though rarely chosen, come chloral, chloroform, paraffine, belladonna, ammonia, cantharides, salts of lead, zinc, and potassium. We give the

average numbers for two successive periods, and the actual numbers for seven years, 1868–74. Besides, wherever count is kept of the poisons chosen, there is always the same result; in Würtemberg, for example, cyanide of potassium, copper, phosphorus, oil of bitter almonds are preferred; and at Vienna, always in the same order, cyanide of potassium, salts of soda, phosphorus, morphia, sulphuric acid, chloroform, arsenic, opium, and chloral.

Poisons chosen by Suicides in England and Wales (1863-74).

Poisons	Yearly average		Yearly actual numbers						
	1863–67	1868–74	1868	1869	1870	1871	1872	1873	1874
Arsenic	5·8	4·6	7	3	3	6	5	5	3
Mercury	3·8	2·7	3	3	2	3	3	2	3
Opium	2·2	2·1	4	1	4	1	—	4	1
Morphia	0·6	1·4	3	1	2	1	1	1	1
Laudanum	20·2	21·8	28	15	21	9	20	37	23
Strychnine	6·0	10·6	10	9	7	13	15	11	9
Prussic acid / Cyanide of potassium	24·2	24·7	14	24	39	23	20	30	23
Oil of bitter almonds	3·8	3·0	14	8	—	—	—	2	2
Oxalic acid	11·0	9·4	7	12	7	18	2	4	7
Sulphuric acid	4·0	2·1	3	1	3	1	3	4	—
Muriatic "	0·6	3·7	2	1	2	3	4	4	10
Nitric "	0·6	2·1	1	1	4	2	1	1	5
Carbolic "	—	5·1	1	1	5	10	4	8	7
Vermin killer	3·4	9·4	5	13	11	6	14	8	9
Aconite	1·4	0·6	2	—	—	—	1	—	1
Phosphorus	0·8	1·4	—	1	1	2	—	1	3
Chloride of zinc	1·0	1·0	—	3	2	1	1	—	—
Chloroform	0·4	0·4	2	—	1	—	—	—	—
Other poisons or not known	40·4	32·4	33	30	32	25	43	22	42

But not less constant is the kind of wounds by weapons of steel, as may be seen in the Prussian returns (1869–75) which here we quote :—

Near Shrewsbury! Found by Dr. Hall, locality unknown to me.

C. SPORIDIA VERY MINUTE, INNUMERABLE.

3. *Tympanis laracina.* (Fckl.)

Cups scattered or cæspitose, erumpent, sessile, totally black, horny; hymenium plane, margined; asci cylindraceo-clavate; sporidia very minute, innumerable.

Pycnidia rotund, closed, at length perforated, black, rugulose; stylospores long, filiform, slender, curved, flowing out in a yellow gelatinous mass.

Cenangium Laracinum—Fckl., "Sys. Myco.," p. 270; "Grevillea," 2, p. 187.

Exs.—Phil., "Elv. Brit.," 145.

On bark of *Larix Europæus.*

Name—*Larix*, the genus to which the larch belongs.

Shrewsbury!

4. *Tympanis ligustri.* Tul.

Gregarious or solitary, erumpent, at first obtuse, then expanded, into a marginate hymenium, substipitate, black, glabrous, between gelatinous and horny, pale within; asci broadly cylindrical; sporidia (?) innumerable, very minute, ovate or ovate-oblong; paraphyses filiform, slender, numerous.

Stylospores (conidia ?) diplodia-form, borne on filiform sporophores, intermixed with the asci and paraphyses.

Tympanis ligustri—Tul., "Select. Fung. Carp.," iii. p. 154; Cooke, "Handbk.," No. 2187. *Tympanis saligna*—Fries, "Sys. Myco.," ii. p. 176 (in part); B. and Br., "Ann. Nat. Hist.," No. 784; Berk., "Outl.," t. 1, f. 10; Gill., "Champ.," p. 197. *Cenangium ligustri*—Fckl., "Symb. Myco.," p. 268.

Exs.—Fckl., "F. Rh.," No. 767; Rabh., "Fung. Eur.," No. 229; Cooke, "Fung. Brit.," ed. ii. 461.

On *Ligustrum vulgare.*

Name—*Ligustrum*, the generic name of the host-plant.

Lucknam, Wiltshire (Messrs. Berkeley and Broome).

5. *Tympanis conspersa.* Fries.

Cæspitose, in round or elongated erumpent groups; cups substipitate, truncate-turbinate, black; hymenium plane or slightly concave, submarginate; asci cylindraceo-clavate; sporidia (?) innumerable, extremely minute; paraphyses filiform, slender, enlarged and brown at the apices, adherent.

Spermogonia usually intermixed with the above, conical or obconical, black; spermatia very minute. (Plate XI. fig. 67.)

Tympanis conspersa—Fries, "Sys. Myco.," ii. p. 175; "Eng. Flo.," v. p. 211; Grev., t. 338; Berk., "Outl.," p. 374; Tul., "Ann. Sc. Nat.," xx. (1853) t. 16, f. 15, 16; Cooke, "Handbk.," No. 2186; Karst., "Myco. Fenn.," p. 226; Gill., "Champ.," p. 197.

Exs.—Fries, "Scl. Suec.," Nos. 12 and 171; Berk., No. 160.

On *Pyrus, Crategus*, etc.

Name—*Conspersus*, sprinkled; distributed on the wood.

Bagley Wood, near Oxford! (Mr. Baxter).

6. *Tympanis Aucupariæ.* (Pers.)

Cæspitose, black, sprinkled with whitish meal, at first spherical, then elongated, somewhat cylindrical, arising from a common stroma, closed, at length open at the apex; hymenium concave, blackish, marginate; asci clavate; sporidia innumerable, extremely minute; paraphyses filiform, slender, slightly enlarged at the summits, brown, adherent.

Spermogonia resembling the early stage of the above; spermatia extremely minute, borne on slender branched sterigmata.

Sphæria Aucupariæ—Pers., "Syn. Fung.," p. 51; A. and S., p. 25. *Cenangium Aucupariæ*—Fries, "Sys. Myco.," ii. p. 181; "Eng. Flo.," v. p. 212; Cooke, "Handbk.," No. 2191. *Peziza Aucupariæ*—Grev., "Flo. Edin.," p. 426.

Exs.—Moug. and Nest., No. 789.

On dead branches of mountain ash.

Name—*Aucuparia*, the specific name of *Pyrus aucuparia*, on which it grows.

Craiglockhart (Dr. Greville).

7. *Tympanis Fraxini.* (Schwz.)

Cæspitose, in elongated erumpent groups; cups subsessile, turbinate-truncate, shining, black; hymenium plane, rugose, marginate; asci broadly clavate; sporidia (?) innumerable, extremely minute; paraphyses filiform, slender.

Peziza Fraxini—Schwz., "Synop.," No. 1262. *Tympanis Fraxini*—Fries, "Sys. Myco.," ii. p. 174; "Eng. Flo.," v. p. 210; Cooke, "Handbk.," No. 2185. *Cenangium Fraxini*—Tul., "Ann. Sc. Nat.," 1853, p. 140.

Exs.—Libert, No. 1029; Roumg., "Fung. Gal.," 1272.

On branches of ash. Winter and spring.

Name—*Fraxinus*, the generic name of the host-plant.

Appin (Capt. Carmichael).

8. *Tympanis alnea.* (Pers.)

Cæspitose, bursting through the bark in rounded groups, shortly stipitate, brownish-black, somewhat horny; hymenium plane or slightly concave, submarginate; asci cylindraceo-clavate; sporidia (?) innumerable, extremely minute; paraphyses filiform, slender, adherent, brown at the summits.

Spermogonia intermixed with the above, subconical or oblong-ovate, opening by a minute pore. Spermatia extremely minute, born on slender branched sporophores.

Peziza alnea—Pers., "Syn. Fung.," p. 673; "Myco Eur.," p. 325. *Tympanis alnea*—Fries, "Sys. Myco." ii. p. 174; "Elench.," p. 18; "Eng. Flo.," v. p. 210; Cooke, "Handbk.," No. 2184 (in part.) *Cenangium alneum*—Fckl., "Symb. Myco.," p. 271 (?).

Exs.—Sommf., No. 191.
On alder.
Name—*Alnus*, the genus to which alder belongs.
Appin !

GENUS V.—CRUMENULA. De Not., "Disc.," p. 9.

Cups superficial, globose, dehiscing with a rounded, entire, or lacerated mouth, when dry closely pressed together; excipulum coriaceous, exceeding the thickish concave hymenium; asci from the slender base nearly cylindrical, 8-spored; paraphyses filiform; sporidia acicular, continuous or septate, delicate hyaline-yellow. (Plate XI. fig. 68.)

Inhabiting branches of shrubs.

Name—*Crumena*, a purse; from its shape.

KEY TO THE SPECIES.

On *vaccinium*	*urceoliformis.*
On *Calluna vulgaris*: sporidia septate	*callunigena.*
On *Calluna vulgaris*: sporidia longer and not septate	*Ericæ.*
On *Arbutus Uva-Ursi*	*Ledi.*

1. *Crumenula urceoliformis.* Karst.

Scattered, generally solitary, erumpent, sessile or subsessile, nearly globose, blackish, brown-furfuraceous, becoming concentrically sulcate and naked, at first closed, then opening with a connivent mouth; disc pale cinereous; asci cylindrical, narrowed at the base; sporidia 8, filiform, $65 \times 2\mu$; paraphyses filiform, forked at the apices. (Plate XI. fig. 68.)

Peziza urceoliformis—Karst., "Mon. Pez.," p. 172.
Crumenula urceoliformis—Karst., "Myco. Fenn.," p. 213.

On dead stems of *Vaccinium Vitis idea.*

Name—*Urceolus*, a little pitcher, *forma*, shape.

Grantown, N.B.! (Rev. Dr. Keith).

2. *Crumenula callunigena.* Karst.

Cups solitary, nearly globose, sessile, brownish-black, naked, striate, mouth connivent; asci cylindrical, with a

slender base; sporidia 8, filiform, very often attenuated at both ends, straight, colourless, simple or slenderly 3-septate, 40—60 × 2·5μ; paraphyses crowded, apex slightly and unequally thickened.

Peziza callunigena—Karst., "Mon. Pez.," p. 171. *Crumenula callunigena*—Karst., "Symb.," p. 251; "Myco. Fenn.," p. 212.

On branches of *Calluna vulgaris*. Autumn.

Cups ·6 mm. broad. I have found this abundantly on decaying branches of *Calluna vulgaris*, and the cups are invariably seated on a blackish-brown tapesium, reminding one of *Tapesia Rosæ* (Pers.), to which it bears some resemblance.

Name—*Calluna*, a genus of *Ericaceæ*, *gigno*, to bear.

Near Clunbury, Salop!

3. *Crumenula Ericæ*. (Fries.)

Solitary, sessile, coriaceo-membranaceous, brownish-black; externally rugose; mouth compressed, connivent; asci cylindrical, narrowed at the base; sporidia 8, filiform, 90 × 1·5μ; paraphyses filiform, slender.

Pycnidia similar to the above; stylospores cylindraceo-fusiform, curved, at length uniseptate, 16 × 2μ.

Cenangium Ericæ—Fries, "Sys. Myco.," ii. p. 188.

Exs.—Phil., "Elv. Brit.," No. 194. Neither Rehm's "Asco.," No. 466, nor Rabh., "Fung. Eur.," 1445.

On dead branches of *Calluna vulgaris*.

Name—*Erica*, a genus of heaths; from its habitat.

Hadnall, Salop!

4. *Crumenula Ledi*. (A. and S.)

Scattered, superficial, sessile, at first closed, and nearly spherical, then depressed at the top, at length hemispherically collapsed, and opening with a broad mouth, rugulose, black; asci subcylindrical (sporidia not seen); paraphyses numerous, filiform.

Peziza Ledi—A. and S., p. 343, t. 10, f. 7; Fries, "Sys. Myco.," ii. p. 114; Nees, f. 264; B. and Br., "Ann. Nat.

Hist.," 160; Cooke, "Handbk.," 2080. *Crumenula Ledi*—Karst., "Myco. Fenn.," p. 214.

On *Arbutus Uva-Ursi*. September.

Sessile, globose-hemispherical; externally rugose, brownish-black; mouth especially shining, greenish, covered with a compact powder; disc dingy.

Glencoe, N.B. (Mr. Churchill Babington).

GENUS VI.—EPHELIS. Fries, "Fung. Mexic.," and "Summa Veg. Scan.," p. 370.

Perithecium (stroma) forming an effused crust; here and there tuberculate, tubercles dehiscing into cup-shaped excipula. (Plate XI. fig. 69.)

Name ἐφηλίς, spots brought out by the sun.

1. *Ephelis Rhinanthi* (nov. sp.).

Cups at first tuberculate, crowded or gregarious, arising from an effused horny crust, at length expanding, patelliform; softish-waxy, black; asci cylindraceo-clavate; sporidia 8, oblong, or clavate, 3-guttulate, $10 \times 5\mu$; paraphyses filiform, slightly enlarged at the apices. (Plate XI. fig. 69.)

Rhytisma radicalis—Cooke, "Grevillea," viii. p. 9 (the immature stage).

On stems near the base, and roots, of *Rhinanthus Crista galli*. Autumn.

The mature cups are about a ¼ of a line broad, sessile, attached by a broadish base, externally rough, internally pale grey. Dr. Cooke finds stylospores which are elongated fusiform, tapering at the extremities to a slender point, with two or more septa, $70 \times 5\mu$. The general appearance is that of a black gouty swelling, the unexpanded cups somewhat like a *Cucurbitaria*.

Name—*Rhinanthus*, the genus to which the yellow rattle belongs.

Near Aberdeen (Mr. J. Taylor). Forres, N.B.! (Rev. Dr. Keith). Osmere, near Whitchurch, Salop!

Order VI.—PATELLARIACEÆ. Fries (in part).

Cups sessile, subcoriaceous or horny, glabrous, orbicular, rarely closed at first, plane or slightly concave, black or dark-coloured (except *P. pallida*); asci cylindraceo-clavate; sporidia 8, coloured or hyaline; epiphytal. (Plate XI. figs. 70–72.)

ARRANGEMENT OF THE GENERA.

I. *Patellaria.* Fries.	III. *Laquearia.* Fries.
II. *Heterosphæria.* Grev.	

KEY TO THE GENERA.

Cups open from the first	*Patellaria.*
Cups covered with a superior deciduous excipulum	*Laquearia.*
Cups at first closed, globose	*Heterosphæria.*

GENUS I.—PATELLARIA. Fries.

Excipulum between coriaceous and horny, naked, black, open from the first; disc punctiform, becoming gradually dilated, firm, acigerous, persistent. (Plate XI. fig. 70.)

ARRANGEMENT OF THE SPECIES.

A. Sporidia elliptic.		
(*a*) Coloured	species	1–3
(*b*) Hyaline, simple	,,	4
(*c*) Hyaline, septate	,,	5
B. Sporidia oblong or oblong-elliptic.		
(*a*) Hyaline, simple	,,	6
(*b*) Hyaline, septate	,,	7–13
C. Sporidia subclavate.		
(*a*) Hyaline, septate	,,	14–16
D. Sporidia fusiform or linear-fusiform.		
(*a*) Hyaline, simple	,,	17, 18
(*b*) Hyaline, septate	,,	19–21
E. Sporidia filiform	,,	22
Doubtful species	,,	23, 24

KEY TO THE SPECIES.

Hymenium white	*atro-alba.*
Hymenium pallid	*pallida.*
Hymenium citrine	*citrina.*
Hymenium olivaceous	*olivacea.*
Hymenium subpruinose; sporidia large	*atrata.*
Hymenium black	1
Hymenium fuliginous or blackish-brown	3

1.	Margin entire; sporidia vermiform	*vermifera.*
	Margin pale; sporidia clavate or fusiform, medium size	*macrospora.*
	Margin flexuous; sporidia minute, elliptic.	*flexella.*
	Margin thin, compressed; sporidia large, 3-septate	*compressa.*
	Margin thin, compressed; sporidia large, simple ..	*connivens.*
	Margin serrated; sporidia smaller, simple	*rubro-tingens.*
	Margin absent	2
2.	Sporidia brown	*Bloxami.*
	Sporidia hyaline; cups seated on a spot-like crust	*Lecideola.*
	Sporidia hyaline; cups emerging through the bark	*subtectum.*
3.	Margin tumid; sporidia brown	*lignyota.*
	Margin crenulate; sporidia hyaline, fusiform, large	*maura.*
	Margin incurved; sporidia hyaline, slender, small	*litoralis.*
	Margin entire; sporidia hyaline, elliptic, minute	*minutissima.*
	Margin entire; sporidia hyaline, oblong-fusiform, very large	*Lonicerae.*
	Margin obtuse; sporidia hyaline, clavate, large ..	*clavispora.*
	Margin vinous-purple; sporidia hyaline, fusiform	*atro-vinosa.*
	Margin absent	4
4.	On dead stems of *Hypericum*: sporidia 3-septate ..	*Hyperici.*
	On dead oak: sporidia 4 to 5-septate	*proxima.*

A. SPORIDIA ELLIPTIC.

(a) *Coloured, septate.*

1. *Patellaria lignyota.* Fries.

Scattered or subgregarious, sessile, when dry horny, when moist softer, applanate, concave, then plane, growing black; margin tumid, subcrenulate; hymenium when moist fuliginous; asci clavate, obtuse; sporidia 8, oblong-ovoid, brown, 1-septate, $10 \times 4\mu$; paraphyses filiform, adherent.

Patellaria lignyota—Fries, "Sys. Myco.," ii. p. 150; B. and Br., "Ann. Nat. Hist.," No. 579; Cooke, "Handbk.," No. 2177. *Arthonia melaspermella*—Nyl. in "Flora," 1855; Leighton, "Lichen Flora," ed. iii. p. 416.

Exs.—Rabh., "Myco. Eur.," 1152; Phil., "Elv. Brit.," No. 146.

On decorticated wood.

Cups about ¼ of a line broad. No visible thallus, and much resembling a *Lecidea*. Opinion will differ as to the alliance of this species, but for the present I prefer to retain it as a fungus

Name—*Lignum*, wood; from the habitat.

Bomere Pool, near Shrewsbury! near London (Mr. F. Currey). Oakley Park, Cirencester! Braydon Pool, Gloucestershire (Mr. Joshua).

2. *Patellaria Bloxami.* Berk.

Gregarious, sessile, applanate, plane or convex, black, flesh blackish-brown, when old immarginate; asci cylindraceo-clavate; sporidia 8, elliptic, uniseptate, brown, 10—15 × 5—8μ; paraphyses numerous, filiform, adherent, slightly thickened and brown above.

Patellaria Bloxami—Berk. in herb. Kew.

On rotten wood.

Cups about ¼ to ½ a line broad. When young it has a very narrow margin.

Name—After the Rev. Andrew Bloxam.

Rev. A. Bloxam, without locality!

3. *Patellaria olivacea.* (Batsch.)

Sessile, applanate, between fleshy and waxy; externally rugulose, olivaceous; hymenium becoming black; margin prominent, tumid, entire, becoming nearly yellow; asci cylindrical; sporidia 8, elliptic or slightly turbinate, polari-guttulate, bluish-green, 9—10 × 4—5μ; paraphyses filiform, rather stout, septate, clavate at the summit.

Peziza olivacea—Batsch, "El.," f. 51; Pers., "Myco. Eur.," p. 306; Fries, "Sys. Myco.," ii. p. 142; B. and Br., "Ann. Nat. Hist.," No. 1077, t. 15, f. 22; Cooke, "Handbk.," No. 2174. *Rhizina nigro-olivacea*—Curr., "Linn. Trans.," xxiv. p. 494, t. 51, f. 10–12.

On rotten willow.

"It runs over the wood in an irregular manner, like the thallus of a *Peltidea*. In its young state it is truly *Peziza*-like, and very beautiful" (B. and Br.). Sporidia 7·6 to 10μ long.

Name—*Oliva*, an olive; of an olive-green colour.

Batheaston! (C. E. Broome, Esq.).

(*b*) *Hyaline, simple.*

4. *Patellaria flexella.* (Fries.)

Immersed, compressed, minute, concave, subcoriaceous, variously flexuose, black; asci clavate; sporidia 8, elliptic, $5 \times 2 \cdot 5\mu$; paraphyses adherent, black at the summit.

Peziza flexella—Fries, "Sys. Myco.," ii. p. 152; "Eng. Flo.," v. p. 207; Cooke, "Handbk.," No. 2125.

Exs.—Moug. and Nest., No. 1094; Roumg., "Stirpes,' 333.

On dead wood, especially pine.

Cups about 100 to 290μ broad. This is usually regarded by lichenologists as a *Xylographa;* but, until this and its allies are grouped on some more satisfactory basis, we retain it here.

Name—*Flexus*, bowed; slightly bent.

Forres, N.B.! (Rev. Dr. Keith).

(*c*) *Hyaline, septate.*

5. *Patellaria minutissima* (nov. sp.).

Gregarious or scattered, very minute, sessile, when dry compressed, when moist expanded; externally blackish-brown; margin entire, incurved; hymenium fuliginous-brown; asci clavate or cylindraceo-clavate; sporidia 8, elliptic, hyaline, 2 to 3-guttulate, at length 3-septate, $6 \times 3\mu$; paraphyses filiform, slightly enlarged at the bent apices.

On decayed wood.

Cups about 300μ broad; when dry somewhat immersed in the wood.

Name—*Minutus*, minute; very minute.

Near Shrewsbury!

B. SPORIDIA OBLONG OR OBLONG-ELLIPTIC.

(*a*) *Hyaline, simple.*

6. *Patellaria pallida.* Berk.

Gregarious, sessile, pallid, with a somewhat obtuse margin; sporidia biseriate, oblong, slightly curved; 12μ long.

Patellaria pallida—Berk., "Ann. Nat. Hist.," No. 1831; "Grevillea," vii. p. 8.

On smooth bark! (Rev. A. Bloxam).

(*b*) *Hyaline, septate.*

7. *Patellaria proxima.* B. and Br.

Orbicular, shield-like, depressed, somewhat immersed, black; hymenium same colour or brown-black; asci clavate; sporidia 8, oblong, obtuse at the ends, slightly curved, 4 to 5-septate, $17—25 \times 5—6\mu$; paraphyses free, filiform, slender, branched.

Patellaria proxima—B. and Br., "Ann. Nat. Hist.," No. 965, t. 16, f. 18; Cooke, "Handbk.," No. 2170. *P. parvula*—Cooke, "Handbk.," 2178.

Exs.—Cooke, "Fung. Brit.," No. 660; Phil., "Elv. Brit.," No. 147.

On dead oak.

"Closely resembling *P. atrata*, but differing materially in the fruit" (B. and Br.).

Name—*Proximus*, nearest, next; from its approaching another species.

Barking! (Berkeley and Broome). Shrewsbury!

8. *Patellaria Hyperici.* Phil.

Gregarious, very minute, innate-sessile, applanate, immarginate, glabrous, blackish-brown; asci broadly clavate; sporidia 8, biseriate, oblong-elliptic, triseptate, $17—20 \times 5—8\mu$; paraphyses filiform.

Patellaria Hyperici—Phil. in "Grevillea," x. p. 69.

On dead stems of *Hypericum*.

Cups 100 to 300μ broad, at first innate, then emerging. The sporidia of this species germinate freely within the ascus, thrusting the germ-tubes through the walls of the ascus; the free sporidia often present a germ-tube twice their length while yet in the hymenium.

Name—*Hypericum*, a genus of *Hypericacea*; growing on *Hypericum*.

Shrewsbury!

9. *Patellaria compressa.* (A. and S.)

Scattered or crowded, minute, innate, thin, blackish, when dry compressed, conchiform; asci clavate; sporidia 8, oblong or oblong-elliptic, 2 to 3-septate, straight or curved, 8—11 × 3·5μ; paraphyses filiform, branched.

Peziza compressa—A. and S., p. 340; "Eng. Flo.," v. p. 207; Cooke, "Handbk.," No. 2124. *Durella compressa*—Tul., "Select. Fung. Carp.," iii. t. 22, f. 8–14; Roumg., "Fung. Gal.," 539; Gill., "Champ.," p. 191.

On dead wood.

This approaches very near to *Patellaria proxima*, B. and Br., but the sporidia are not so large.

Name—*Compressus*, pressed together; having the margin pressed together.

Appin.

10. *Patellaria lecideola.* (Fries.)

Sessile, minute, somewhat horny, concave, black, seated upon a cinereous spot-like crust; asci clavate; sporidia 8, elliptic or oblong-elliptic, pseudo-3-septate, 9—16 × 4—5μ; paraphyses filiform, slender.

Peziza lecideola—Fries, "Obs. Myco.," i. p. 166, t. 4, f. 1; Karst., "Pez. et Ascob.," p. 41; "Mon. Pez.," p. 167; Nyl., "Pez. Fenn.," p. 64. *Patellaria lecideola*—Karst., "Myco. Fenn.," p. 234; Cooke, "Handbk.," No. 2179; Gill., "Champ.," p. 191.

Exs.—Fries, "Scl. Suec.," 157; Karst., "Fung. Fenn.," 641.

On dead wood. Karsten says poplar and birch.

Name—*Lecidea*, a genus of lichens; like a small *Lecidea*.

Shere, Surrey! (Dr. Capron).

11. *Patellaria Lonicerœ* (nov. sp.).

Gregarious, minute, sessile, subhemispherical, then partly expanded, black; hymenium concave, fuliginous; margin incurved; asci broadly clavate; sporidia 8, elongate-oblong or oblong-fusiform, 6 to 7-guttulate, becoming

pseudo-6-septate, straight or curved, 25—45 × 4—7μ; paraphyses filiform, slender.

On dead wood of *Lonicera*.

Cups 300μ broad.

Name—*Lonicera*, the genus to which the honeysuckle belongs; on honeysuckle.

Darnaway, N.B.!

12. *Patellaria connivens.* (Fries.)

Gregarious, minute, innate; hymenium depressed, black or rufescent; margin thin; when dry compressed and difformed; asci broadly clavate; sporidia 8, oblong-fusiform, 6 to 8-guttulate, at length pseudo-septate, 14—26 × 4—6μ; paraphyses filiform, very slender, branched from the base, abundant.

Peziza connivens—Fries, "Sys. Myco.," ii. p. 151; Nyl., "Pez. Fenn.," p. 65; Karst., "Mon. Pez.," p. 167; Phil. and Plow., "Grevillea," x. p. 69. *Patellaria connivens*—Karst., "Myco. Fenn.," 234.

Exs.—Karst., "Fung. Fenn.," 641.

On dead wood of willow. Karsten says alder, poplar, and birch also.

Cups about 500 to 800μ broad. The wood is tinged from white to green on the spot where it grows.

Name—*Conniveo*, to wink; from the closing up of the margin.

Shrewsbury!

13. *Patellaria subtectum* (nov. sp.). Cooke.

Singly or in clusters, appearing first as black conical points emerging through the layers of bark, in which condition no fructification is seen; at length the conical points expand into lens-shaped or *Lecidea*-like discs, which are immarginate and black, about ¼ of a line broad or less; substance soft and fragile; asci broadly clavate, narrowed into a slender stem; sporidia 8, oblong-elliptic, 3 to 4-guttulate, at length 1 to 3-septate, 20—24 × 5—6μ; paraphyses filiform, slender. Stylospores in the same hymenium, elongated, cylindrical, 5 to

8-guttulate, curved, on short sporopores seated amongst the asci, 30—50 × 5μ.

On inner bark of *Cistus laurifolius.* June.

Name—*Sub,* under, *tectum,* roof; concealed by the bark.

Royal Gardens, Kew! (Dr. M. C. Cooke).

C. SPORIDIA SUBCLAVATE.

(*a*) *Hyaline septate.*

14. *Patellaria atrata.* (Hedw.)

Subcoriaceous, patelliform, sessile, plane, black; margin swollen; hymenium subpruinose; asci cylindraceo-clavate; sporidia subclavate, 5 to 7-septate, 35—46 × 6μ; paraphyses filiform, adherent, black, and thickened at the apices.

Lichen atratus—Hedw., "Mus. Frond.," ii. p. 61, t. 21, f. A. *Peziza patellaria*—Pers., "Syn. Fung.," p. 670; "Myco. Eur.," p. 306; D. C., "Flo. Fr.," ii. p. 76; A. and S., p. 341; Nees, "Sys.," f. 265. *Peziza-atrata*—Wahl., "Ups.," p. 466; Fries, "Sys. Myco.," ii. p. 160; "Eng. Flō.," v. p. 208; Cooke, "Handbk.," p. 716. *Lecanidion atrum*—Rabh., "Handb.," p. 342; Fckl., "Symb. Myco.," p. 266; Pat., p. 31, f. 72

Exs.—Rabh., "Fung. Eur.," 33; Fckl., "F. Rh.," 1118; Phil., "Elv. Brit.," 90; Cooke, "Fung. Brit.," ed. ii. 194; Roumg., "Fung. Gal.," 828.

On dead wood.

Cups about ½ a line broad. Firm, orbicular; margin prominent.

Name—*Ater*, black.

King's Lynn! (Mr. C. B. Plowright). Conway, North Wales! (Rev. W. A. Leighton). Trefriw, North Wales! Attingham, Shrewsbury!

15. *Patellaria clavispora.* B. and Br.

Scattered, sessile, when young nearly globose, when older expanding, plane, obtusely margined, rather irregular, pitch-brown; white within; asci cylindraceo-

clavate; sporidia 8, clavate or clavate-fusiform; 3 to 6-septate; $30 \times 5\mu$; paraphyses filiform, the summits branched, moniliform, brown, somewhat adherent. (Plate XI. fig. 70.)

Patellaria clavispora—B. and Br., "Ann. Nat. Hist.," No. 774; Cooke, "Handbk.," No. 2166.

On twigs of privet.

Cups $\frac{1}{4}$ to $\frac{1}{2}$ a line broad. Externally like *P. atrata*, but differing in the asci, sporidia, and paraphyses.

Name—*Clava*, a club, *σπόρος*, seed; from the shape of the sporidia.

Lucknam, Wiltshire!

16. *Patellaria macrospora* (Fckl.)

Gregarious, minute, sessile, at first subhemispherical, then nearly plane, black, glabrous, margin cinereous; asci clavate; sporidia 8, clavate or fusiform, straight or curved, guttulate, becoming 3-septate, 15—20×2—3μ; paraphyses filiform, branched, more or less adherent, summits subglobose, brown.

Durella macrospora—Fckl., "Symb. Myco.," 281.
Peziza nigro-punctata—Gerard.

Exs.—Phil., "Elv. Brit.," 131.

On oak-wood.

Name—*μακρός*, large, *σπόρος*, seed; large-spored.

North Wales!

D. SPORIDIA FUSIFORM OR LINEAR-FUSIFORM.

(*a*) *Hyaline, simple.*

17. *Patellaria rubro-tingens*. B. and Br.

Contiguous, forming crust-like, elongated groups; cups minute, hemispherical, concave, black, rugose; margin tinged with dark reddish-brown, serrated, incurved; asci clavate; sporidia 8, narrowly fusiform, 3 to 4-guttulate, 8—$14 \times 2\mu$; paraphyses filiform, rather stout.

Patellaria rubro-tingens—B. and Br. in Herb. Berk.

On oak.

Cup about 1 line broad, forming a continuous layer, but sometimes separate.

Name—*Ruber*, red, *tingo*, to dye.

Batheaston! (Mr. C. E. Broome).

18. *Patellaria litoralis.* Phil. and Plow.

Cups scattered or crowded, minute, black; hymenium fuliginous-brown, concave; margin incurved, serrated; asci cylindraceo-clavate; sporidia 8, linear-fusiform, 3 to 6-guttulate, straight or a little bent, 25 × 2μ; paraphyses filiform, slender.

Peziza (Mollisia) litoralis—Phil. and Plow., "Grevillea," iv. p. 121, t. 62, fig. 4; Steven., "Myco. Scot.," p. 324.

On dead wood washed up from the loch.

Cups about 500 to 800 lines broad; externally granular.

Name—*Litus*, the shore; found on the shore of the loch.

Lynwilg, N.B.! (Rev. Dr. Keith).

(*b*) *Hyaline, septate.*

19. *Patellaria maura*—Phil. and Plow.

Cups sessile, scattered, at first globose, becoming patellate, fuliginous-black; margin raised, crenulate; asci cylindraceo-clavate; sporidia 8, narrowly elongate-fusiform or subcylindrical, straight or curved, 30—38 × 5—6μ; paraphyses filiform, summits hooked.

Peziza (Mollisia) maura—Phil. and Plow., "Grevillea," iv. p. 122, t. 62, f. 3.

On dead wood. Autumn.

Cups about ½ a line broad. The margin is torn; the asci have a narrow elongated base, and the paraphyses are hooked or even curled at the summit.

Name—*Maurus*, a Moor; dusky-coloured.

Dinmore, Herefordshire!

20. *Patellaria atro-vinosa.* Blox. (not Berk. and Rav.).

Gregarious or crowded, minute, round or of irregular outline, almost black, distinctly margined; margin vinous-purple; asci elongate-clavate; sporidia 8, tinged with green, fusiform or linear-fusiform, pseudo-3-septate, straight or curved, 17—20 × 3—4μ; paraphyses filiform, slender, branched.

Patellaria atro-vinosa—Blox., MS.; Curr., "Linn. Trans.," xxiv. p. 155, t. 25, f. 31; B. and Br., "Ann. Nat. Hist.," No. 10; Cooke, "Handbk.," No. 2171.

On bark.

Cups $\frac{1}{4}$ to $\frac{1}{2}$ a line broad. The disc is blackish-brown; the margin lighter brown, and somewhat prominent.

Name—*Ater*, black, *vinosus*, colour of red wine.

Gopsal, near Twycross! (Rev. A. Bloxam).

21. *Patellaria atro-alba.* Cooke.

Gregarious or scattered, small, sessile, at length plane, black; disc white; sporidia fusiform, 7-septate, hyaline.

Cooke's "Handbk.," No. 2168.

On decorticated sticks.

Variable in size, usually gregarious, but always small; readily distinguished from its allies by the white disc; sporidia broadly fusiform, ·0013 inch (30μ) long (Cooke).

E. SPORIDIA FILIFORM.

(*a*) *Hyaline, septate.*

22. *Patellaria vermifera* (nov. sp.).

Scattered, sessile, very minute, cupulate, then patelliform, black, glabrous; margin entire; asci broadly clavate; sporidia 8, narrowly cylindrical, vermiform, multiguttulate, 30—35 × 3μ; paraphyses slenderly filiform, abundant, branched.

On dead branches of decorticated holly.

Cups about 500μ broad.

Name—*Vermis*, a worm, *fero*, to bear; from the shape of the sporidia.

Dolgelly, North Wales!

Doubtful Species.

23. *Patellaria citrina* (Cheval.). B. and Br.

Cups plane; externally pallid; hymenium lemon-coloured; asci clavate; sporidia filiform.

Patellaria citrina—B. and Br., "Ann. Nat. Hist.," No. 583; Berk., "Outl.," p. 373. *Ascobolus citrinus*—Cheval., "Flo. En. Par.," i. t. 31; Cooke, "Handbk.," 2165.

On rose-twigs lying in a running stream. April.

Our plant answers exactly in outward appearance to that of Chevallier, having a broad, flat, yellow hymenium, with a pale border. The asci are clavate, and contain long filiform sporidia. We suspect that these are what M. Chevallier calls asci, considering the included granules as sporidia, exactly as Madame Libert has done in *Stictis Sesleriæ* (B. and Br.).

Penllergare, near Swansea (Mr. M. Moggridge).

The affinity of this species is somewhat doubtful, and there being but a single cup in Mr. Berkeley's herbarium, it cannot be examined without the risk of destroying it.

24. *Patellaria melaxantha*. Fries.

Sessile, waxy, dry, patellate; externally approaching black; margin very entire; hymenium yellowish.

Peziza melaxantha—Fries, "Sys. Myco.," ii. p. 150. *Patellaria melaxantha*—Fries, "Summa Veg. Scan.," p. 366. *Peziza melanotheja*—Fries in Cooke's "Handbk.," No. 2123 (?).

There is some confusion in Fries's "Sys. Myco." with regard to this name, the author having named two different plants by it. Whether both have occurred in Britain is doubtful.

GENUS II.—HETEROSPHÆRIA. Grev.

Perithecium sessile, globose-depressed, umbilicate above, at length open and irregularly torn, thin, coriaceous, black; disc thick, placentiform; sporidia 8.

Pycnidia similar to the above; stylospores slenderly fusiform, curved. (Plate XI. fig. 71.)

Name—ἕτερος, different, σφαῖρα, a sphere; different from the normal *Sphæria*.

1. *Heterosphæria patella* (Tode). Grev.

Erumpent, sessile, free, at first more or less olivaceous, at length black, even or striate; disc depressed, rarely open, dirty white, and then crowned with a toothed border; sporidia biseriate, oblong, rounded at the ends, slightly curved, mostly uniseptate, when mature triseptate, 13—16 × 3—4μ; paraphyses filiform.

Pycnidia similar to the above, and more generally found; the stylospores slenderly fusiform, acute at both ends, 25—30 × 3·5μ; sterigmata short, filiform, sometimes branched.

Asci and stylospores sometimes found associated on the same disc. (Plate XI. fig. 71.)

Heterosphæria Patella—Grev, t. 103; Fries, "Elench.," ii. p. 133; Berk., "Outl.," p. 379; Cooke, "Handbk.," No. 2275; Tul., "Select. Fung. Carp.," iii. p. 174, t. 18, f. 16–22; Karst., "Myco. Fenn.," p. 222; Gill., "Champ.," p. 188. *Sphæria penetrans*, a. *patella*—Tode, "Fung. Meckl.," ii. p. 45, f. 121. *Sphæria patella*—Pers., "Syn. Fung.," p. 76; Fries, "Sys. Myco.," ii. p. 511. *Peziza fimbriata*—Chaill., "Sec. Fr." *Peziza Chailletii*—Pers., "Myco. Eur.," i. p. 288. *Phacidium patella*—Fries, "Elench.," ii. pp. 133, 134; "Eng. Flo.," v. p. 291; Rabh., "Krypt. Flo.," i. p. 160. *Tympanis patella*—Wallr., "Crypt. Flo.," p. 425.

Exs.—Fries, "Scl. Suec.," No. 369; Moug. and Nest., No. 485; Desm., "Crypt. Fr.," ed. i. No. 215, and ed. ii. No. 415; Berk., 289; Rabh., "Herb. Myco.," ed. ii. 446, 447;

"Fung. Eur.," 839; Karst., "Fung. Fenn.," 930; Cooke, "Fung. Brit.," 276.

On dead herbaceous stems.

Name—*Patella*, a saucer.

Common!

GENUS III.—LAQUEARIA. Fries.

Disc waxy, persistent, without any hypothecium, but covered with a horny, coriaceous, dimidiate, superior, deciduous excipulum; mouth contracted (Berk., "Outl.," p. 373). (Plate XI. fig. 72.)

Name—*Laquear*, a roof; from its peculiar form.

1. *Laquearia sphæralis*. Fries.

Erumpent, hemispherical, brown-black, urceolate; mouth contracted, entire; disc plane, black; asci oblong, sessile; sporidia minute, oblong-elliptic, hyaline, simple. (Plate XI. fig. 72.)

Laquearia sphæralis—Fries, "Summa Veg. Scan.," p. 366; Berk., "Outl.," p. 373; Fckl., "Symb. Myco.," p 250; Cooke, "Handbk.," No. 2182. *Stictis Sphæralis*—Fries, "Sys. Myco.," ii. p. 194; "Eng. Flo.," v. p. 213.

Exs.—Fckl., "F. Rh.," No. 2066.

On dead, decorticated branches of the ash. Winter.

Introduced entirely on the authority of Mr. Purton; I have seen no specimens (M. J. Berkeley, *l. c.*).

Order VII.—STICTEÆ. Fries.

Receptacle nearly obsolete, immersed in the matrix; hymenium even, determinate, orbicular or elliptic, margined by the matrix or a ring of its own; asci cylindrical or clavate; sporidia elliptic, fusiform or elongate-filiform. (Plates XI., XII. figs. 73–75.)

The excipulum is reduced to a thin membranaceous layer, which is immersed in the matrix, and adnate to it.

In *Propolis* there is a thin subhymenial tissue, but in *Schmitzomia* and *Stictis* this is all but obsolete.

Inhabiting dead bark, wood, herbaceous stems, etc.

Name—From the typical genus.

ARRANGEMENT OF THE GENERA.

I. *Propolis.* Fries.	III. *Stictis.* Fries.
II. *Schmitzomia.* Fries.	

KEY TO THE GENERA.

Hymenium immersed, waxy, plane; sporidia oblong or elliptic	*Propolis.*
Hymenium deeply immersed; sporidia elongate-filiform	*Schmitzomia.*
Hymenium deeply immersed; sporidia not filiform	*Stictis.*

GENUS I.—PROPOLIS. Fries, "Elench.," p. 372.

Hymenium irregular, immersed, waxy, plane, surrounded by an accessory margin; excipulum indistinct or absent; asci cylindracco-clavate; sporidia 4 or 8, oblong or oblong-elliptic; paraphyses filiform, adherent. (Plate XI. fig. 73.)

Excipulum membranaceous, immersed, adnate to the matrix, at length erumpent, and splitting in a stellate manner, the matrix often forming a second margin. The subhymenial tissue is more developed than in the two succeeding genera, and the hymenium is plane or concave, rarely if ever urceolate; asci clavate; sporidia elliptic or oblong-elliptic.

On dead wood and bark.

Name—*Propolis*, bee-glue, which the hymenium is like.

ARRANGEMENT OF THE SPECIES.

A. Sporidia elliptic	species	1
B. Sporidia oblong	„	2–4
C. Sporidia fusiform	„	5
D. Sporidia cylindrical	„	6, 7

KEY TO THE SPECIES.

Hymenium black	*pyri.*
Hymenium greyish-green	*angulosa.*
Hymenium reddish; margin golden-yellow ..	*chrysophæa.*

	Hymenium golden-yellow	*Lecanora.*
	Hymenium whitish	1
1.	Margin spurious; disc rosy-white	*rhodoleuca.*
	Margin laciniate; disc farinaceous-white	*versicolor.*
	Margin laciniate; on rose-branches	*Rosæ.*

A. SPORIDIA ELLIPTIC.

1. *Propolis Lecanora.* (Schum.)

Scattered, gregarious or confluent, erumpent, surrounded by the lacerated bark, at first closed, globose-depressed, then open, patelliform; the true margin fimbriate; hymenium golden-yellow, becoming brown; flesh at first soft, at length firm; asci cylindraceo-clavate; sporidia 8, elliptic or oblong-elliptic, with one or two large guttæ, $25 \times 12\mu$; paraphyses filiform, slightly enlarged at the apices, adhering in a yellow glutine.

Pycnidia intermixed with the above, occupying the sides or summit of the same stroma, disc-shaped; stylospores oblong or oblong-elliptic, straight or slightly curved, issuing through the narrowly perforated epidermis; sterigmata branched, rather stout.

Peziza Lecanora—Schm. and Kunz., exs. 174. *Stictis Lecanora*—Fries, "Sys. Myco.," ii. p. 193; and "Summa Veg. Scan.," p. 373; Wallr., "Flo. Germ.," ii. p. 443; B. and Br., "Ann. Nat. Hist.," No. 1172; Cooke, "Handbk.," No. 2227. *Peziza ocellata*—Pers., "Syn. Fung.," p. 667; and "Myco. Eur.," i. p. 313. *Stictis ocellata*—Fries, "Sys. Myco.," ii. p. 193; "Summa Veg. Scan.," p. 373; Tul., "Select. Fung. Carp.," iii. p. 128, t. 18, f. 1–11; Gill., "Champ.," figure only. *Propolis Lecanora* and *P. Populi*—De Not., "Disc.," p. 10.

Exs.—Schm. and Kunze, No. 174; Desm., "Crypt. Fr.," ed. i. No. 869, and ed. ii. No. 69; Rabh., "Herb. Myco.," ed. ii. No. 519; "Fung. Eur.," ii. No. 457, 787; Karst., "Fung. Fenn.," 555; Winter, "Fungi Eur.," 2641; Kunz., "Fung. Sel.," 366.

On various species of *Salix*, and on *Populus*.

Disc about ½ a line broad, circular or oblong, surrounded by the torn bark, which forms a fringe. The colour is a reddish-yellow or dark brown.

Name—*Lecanora*, a genus of lichens.
Jedburgh (A. Jerdon). Oxford! (Baxter).

B. SPORIDIA OBLONG.

2. *Propolis pyri.* (B. and Br.)

Gregarious or confluent, erumpent, orbicular; hymenium plane or concave, black, surrounded by a laciniate margin; asci cylindraceo-clavate; sporidia 8, oblong or oblong-elliptic, with 1 or 2 large guttæ, slightly tinted brown, 15—20 × 8μ; paraphyses filiform, slender, adherent in a dark purple gelatine.

Stictis Lecanora (Schum.) var. *pyri*—B. and Br., "Ann. Nat. Hist.," No. 1624, t. 11, f. 7; "Grevillea," v. p. 62.

Exs.—Phil., "Elv. Brit.," No. 148.

On bark of pear-trees.

Disc about ½ a line broad. The sporidia are smaller than in *S. Lecanora*, the paraphyses slenderer, and the hymenial gelatine is purple, not yellow.

Name—*Pyrus*, the genus to which the pear belongs.

Shrewsbury! Sutton Coldfield, Warwick! (Mr. W. B. Grove).

3. *Propolis rhodoleuca.* (Sommf.)

At first immersed, then erumpent, ovate, plane, rosy-white, pruinose, yellow within, surrounded by a spurious margin; asci broadly clavate; sporidia 8, oblong or oblong-elliptic, often plane on one side, becoming 1-septate, 17—20 × 7—10μ; paraphyses filiform, slender.

Stictis rhodoleuca—Sommf., "Lapp.," p. 198; Fries, "Sys. Myco."; "Elench.," ii. p. 26.

On cones of *Pinus sylvestris.*

Cups 1 to 2 lines long. Much resembling *P. versicolor*, from which it differs little except in colour.

Name—ῥόδον, a rose, λευκός, white; rose-white.

In the late Mr. F. Currey's herbarium, now at Kew!

Var. *Strobilina.* (Desm.)

Solitary or gregarious, angular, nearly circular or oblong, plane, white within; hymenium milk-white,

farinose, becoming spadiceous; asci clavate; sporidia 8, oblong, obtuse, slightly bent, with 2, 3, or even 4 guttæ, 15μ long.

Stictis versicolor, Fries, var. *Strobilina*—Desm., "Ann. Sc. Nat.," 1842, p. 52.

Exs.—Desm., "Crypt. Fr.," ed. i. No. 1316, and ed. ii. No. 716.

On cones of *Pinus sylvestris.*

Cups ½ a line broad; when elongated they may be 1½ lines long.

Desmaziere remarks that there is no danger of confounding this with *P. rhodoleuca*, which has a rosy-white disc, is yellow within, and has didymus (uniseptate) sporidia; but the probability is that they are only conditions of the same plant, and in the estimation of some would both be regarded as not specifically distinct from *P. versicolor.*

Name—*Strobilos*, a pine-cone.

4. *Propolis versicolor.* Fries.

Immersed, suboblong, plane; margin spurious, laciniate; hymenium at length farinaceous; asci broadly clavate; sporidia oblong, rounded at the ends, slightly curved, with 2 or more guttæ, $24—30 \times 7—9\mu$; paraphyses filiform. (Plate XI. fig. 73.)

Stictis Propolis versicolor—Fries, "Sys. Myco.," ii. p. 198; Cooke, "Handbk.," No. 2230; Corda, "Icon.," ii. t. 15, f. 133. *Propolis versicolor*—Fries, "Summa Veg. Scan.," p. 372; Gill., "Champ.," p. 182, c. i.; Pat., p. 30, f. 70. *Cryptomyces versicolor*—"Eng. Flo.," v. p. 214. *Propolis faginea* (Schrad.)—Karst., "Myco. Fenn.," p. 244.

Exs.—Fries, No. 276; Fckl., "F. Rh.," 1109; Rav., "Fung. Am.," 315, 316; Roumg., "Fung. Gal.," 1962; Cooke, "Fung. Brit.," ed. ii. 463.

On pales, chips, sticks, etc.

Fries names four varieties of this species, but, as no regard was paid by him to the sporidia, it would be vain to attempt any definition of these.

Name—*Versicolor*, changing colour.
Common!

C. SPORIDIA FUSIFORM.

5. *Propolis chrysophæa.* (Pers.)

Scattered, erumpent, orbicular; hymenium concave, reddish; border rather thickened, golden yellow; asci cylindraceo-clavate or cylindrical; sporidia 8, fusiform, simple, 9—11 × 2μ; paraphyses filiform, slender, sometimes branched in the upper part, and slightly thickened at the apices.

Peziza chrysophæa—Pers., "Syn. Fung.," p. 674; "Icon. Pict.," p. 17, t. 8, f. 1, 2. *Stictis chrysophæa*—Pers., "Myco. Eur.," p. 335; B. and Br., "Ann. Nat. Hist.," No. 966, t. 16, f. 19; Cooke, "Handbk.," No. 2226.

On wych-elm.

About ½ to ¾ of a line broad.

Name—χρυσός, gold, φαιός, dusky; dingy golden.

Batheaston! (Mr. C. E. Broome in Berkeley's herb., Kew.)

D. SPORIDIA CYLINDRICAL.

6. *Propolis Rosæ.* Fckl.

Disc erumpent, nearly convex, white, size and form variable; asci cylindrical, stipitate; sporidia biseriate, cylindrical, bent, obtusely rounded at each end, 2 guttæ, hyaline, 24—26 × 7—8μ; paraphyses filiform, same length as the asci.

Propolis Rosæ—Fckl., "Symb. Myco.," p. 254.

Exs.—Fckl., "F. Rh.," 1276.

The sporidia in my specimen become 2 pseudo-septate; asci 118 × 12μ. Fuckel regards *Exidia saccharina*, Fries, as the conidial stage of this species.

On fallen branches of *Rosa canina*.

Name—*Rosa*, the genus to which *Rosa canina* belongs, on which it is found.

Trefriw, North Wales!

7. *Propolis angulosa.* Karst.

Gregarious, immersed and innate in the parenchyma of the bark, primarily covered, then seated on the epidermis, at first tinted with a somewhat blue colour, erumpent, often encircled by four obtuse triangular lacinæ; angular, or rarely angular or subrotund, plane; hymenium greyish-green, mealy; asci elongate-clavate; sporidia 8, elongate, curved, somewhat yellowish-green, hyaline, 16—23 × 3—4μ; paraphyses not very distinct.

Propolis angulosa—Karst., "Myco. Fenn.," p. 244.

On branches of *Salix*.

About ½ to ¾ of a line broad.

Name—*Angulosus*, angular.

Trefriw, North Wales!

Genus II.—Schmitzomia. Fries.

Disc immersed, encircled by a dehiscent, substellate, distinct, suberose, friable ring; asci cylindrical, slender elongated; sporidia 8, filiform. (Plate XII. fig. 74.)

The excipulum is reduced in this genus to a very thin membrane, which is wholly adnate to the matrix, at first closed, then open; the mouth encircled by a superficial, more or less persistent, usually white ring. The asci are very long and slender, splitting at their summits, allowing the still slenderer, nearly equally long, filiform sporidia to escape. *S. Berkeleyana* is sometimes superficial.

Inhabiting dead wood, herbaceous stems, etc.

Name—After J. Schmitz, and μνεία, a tribute of respect.

Arrangement of the Species.

A. Hymenium blackish	.. .. .. species	1, 2
B. Hymenium ochraceous or pallid ..	.. ,,	3
C. Hymenium testaceous or orange-yellow	,,	4
D. Hymenium whitish or bluish-white	.. ,,	5, 6

Key to the Species.

Margin laciniate, radiating	*radiata.*
Margin entire, yellowish-green	*Berkeleyana.*
Margin entire	1

1.	On clematis: minute	*atro-alba.*
	On honeysuckle: larger	*annulata.*
	On *Arundo phragmites*: sporidia multiseptate ..	*arundinacea.*
	On pine-leaves	*nivea.*

A. HYMENIUM BLACKISH.

1. *Schmitzomia atro-alba* (nov. sp.). Phil. and Plow.

Scattered, orbicular, urceolate, at first closed, then open; margin entire, narrow, white, soon falling off; hymenium nearly black; asci cylindrical; sporidia 8, filiform, 90 × 1μ; paraphyses filiform, slender. (Plate XII. fig. 74.)

On clematis branches.

About 30 to 60μ broad. The small size and blackish disc separate it from other British species.

Name—*Ater*, black, *albus*, white; from the black hymenium and white margin.

Dinmore, Herefordshire! (Mr. C. B. Plowright).

2. *Schmitzomia Berkeleyana.* (D. R. and Lév.)

Scattered or somewhat scattered, crumpent, superficial, orbicular, nearly plane or patelliform, almost yellow-greenish, at length discoloured, growing pale or cinereous, pale or white within, pulverulent; margin scarcely or not at all exserted, very entire; hymenium olivaceous or nearly black, also primarily farinose; asci cylindrical; sporidia filiform, septate, 150—200 × 1·5—2μ; paraphyses numerous, filiform.

Stictis Berkeleyana—Dr. and Lév., "Flo. Alger.," t. 89, f. 8; Gill., "Champ.," p. 180. *Schmitzomia decipiens*—Karst., "Symb.," p. 253; "Myco. Fenn.," p. 240.

Exs.—Moug. and Nest., 1346.

On dead stems of *Artemisia vulgaris*.

North Wootton! (Mr. C. B. Plowright). Sandy Lane, Bristol! (Mr. C. Bucknall).

B. HYMENIUM OCHRACEOUS OR PALLID.

3. *Schmitzomia annulata.* (Cooke and Phil.)

Gregarious or scattered, orbicular, urceolate, margin snow-white, entire, annulate; hymenium ochraceous or

pallid; asci cylindrical, long; sporidia filiform, somewhat flexuose, 160—180 × 1μ; paraphyses filiform, very slender.

Stictis annulata—Cooke and Phil., "Grevillea," ix. p. 8.

On honeysuckle.

Cup 300 to 500μ broad; asci 170 × 7μ.

Name—*Annulatus*, ringed.

Oswestry, Salop!

C. HYMENIUM TESTACEOUS OR ORANGE-YELLOW.

4. *Schmitzomia radiata.* (Linn.)

Gregarious or scattered, immersed, urceolate, at first closed, then open; margin reflexed and divided into radiating obtuse laciniæ; hymenium testaceous or nearly orange-yellow; asci cylindrical; sporidia 8, filiform, at length multiseptate, 150—250 × 2·5—3μ; paraphyses numerous, filiform, slender.

Lycoperdon radiatum—Linn., "Spec. Plant." *Sphærobolus rosaceus*—Tode, "Fung. Meckl.," i. p. 44, t. 7, f. 58. *Stictis radiata*—Pers., "Obs.," ii. p. 73; "Syn. Fung.," p. 674; "Myco. Eur.," i. p. 336; Fries, "Sys. Myco.," ii. p. 194; Wallr., "Flo. Germ.," ii. p. 144; "Eng. Flo.," v. p. 213; Grev., t. 227; Cooke, "Handbk.," No. 2220; Gill., "Champ.," p. 179. *Peziza marginata*—Sow., t. 16.

Exs.—Berk., No. 70; Baxt, 80; Karst., "Fung. Fenn.," 769; Rehm, "Asco.," 122; Winter, "Fungi Eur.," 2735.

On wood, twigs, etc.

Name—*Radio*, to shed beams; from the radiating margin.

Appin (Capt. Carmichael). Near Manchester! (Mr. Brittain).

D. HYMENIUM WHITISH OR BLUISH-WHITE.

5. *Schmitzomia arundinacea.* (Pers.)

Scattered, immersed, orbicular, urceolate, at first closed, then open; margin prominent, entire or nearly entire, whitish pulverulent; hymenium whitish or bluish-white; asci cylindrical, very long; sporidia 8, filiform,

multiseptate, 230—240 × 1·5—2μ; paraphyses filiform, very slender.

Stictis arundinacea—Pers., "Myco. Eur.," i. p. 336; Fries, "Sys. Myco.," ii. p. 195; "Summa Veg. Scan.," p. 373; Gill., "Champ.," p. 179. *Stictis graminum*—Desm. (?).

On *Phalaris arundinacea*, Linn.

About ¼ of a line broad.

Name—*Arundinacea*, the specific name of the grass on which it is found.

Towyn, North Wales!

6. *Schmitzomia nivea*. (Pers.)

Scattered, immersed, at first covered by the whitened epidermis, which at length splits longitudinally and falls away, revealing the elliptic, pallid hymenium; asci cylindrical or cylindraceo-clavate; sporidia 8, linear, thickened near one end, pointed, multinucleate, 100 × 3μ; paraphyses filiform, slender, adherent.

Stictis nivea—Pers., "Myco. Eur.," iii. p. 339; Fries, "Sys. Myco.," ii. p. 196; Berk., "Ann. Nat. Hist.," No. 167; Cooke, "Handbk.," No. 2223. *Propolis nivea*—Fries, "Summa Veg. Scan.," 372. *Schmitzomia nivea*—De Not., "Disco.," 8. *Næmacyclus pinastri*—Fckl., "Symb. Myco.," Nacht ii. p. 50.

Exs.—Desm., No. 763; Moug. and Nest., No. 1095; Rabh., "Herb. Myco.," ii. 712; Rabh., "Fung. Eur.," 812; Fckl., "F. Rh.," 1110; Phil., "Elv. Brit.," 149; Cooke, "Fung. Brit.," ii. 661; Sacc., "Myco. Ven.," 1200; "Erb. Crit. Ital.," ii. 890; Roumg., "Fung. Gal.," 542.

On pine-leaves. Common.

Name—*Niveus*, snow-white.

Near Shrewsbury!

Genus III.—Stictis. Pers.

Disc orbicular, immersed, at first urceolate, closed, then open, marginate, persistent; sporidia elliptic, oblong-elliptic, fusiform or linear. (Plate XII. fig. 75.)

As in the preceding genus, the excipulum is membranaceous, adnate to the matrix, more or less immersed, orbicular or sometimes a little elongated, opening at the top, but mostly without the distinct, friable ring of the preceding; sporidia elliptic, oblong-elliptic, fusiform or linear, often pseudo-septate.

On dead wood, herbaceous stems, etc.

Name—στικτός, pricked; like punctures in the wood.

ARRANGEMENT OF THE SPECIES.

A. Sporidia elliptic	species	1–3
B. Sporidia clavate	„	4
C. Sporidia fusiform	„	5–8
D. Sporidia doubtful	„	9

KEY TO THE SPECIES.

	Hymenium urceolate	1
	Hymenium somewhat superficial	3
1.	Hymenium black: on grass	*graminum.*
	Hymenium greyish-black: on *Cladonia*	*lichenicola.*
	Hymenium reddish-brown	*punctiformis.*
	Hymenium pallid or yellowish	2
2.	Sporidia simple, fusiform	*Fagicola.*
	Sporidia 3 to 5-septate	*pallida.*
3.	Hymenium some shade of brown	4
	Hymenium blackish: on wood	*microstoma.*
4.	Sporidia clavate	*pteridina.*
	Sporidia fusiform; cups arranged in linear series	*seriata.*
	Sporidia fusiform; cups scattered, resembling an *Hysterium*	*hysterioides.*

A. SPORIDIA ELLIPTIC.

1. *Stictis lichenicola.* Mont.

Erumpent, between fleshy and waxy, cupuliform; hymenium grey-black, nearly plane; margin obtuse, blackish, cinereous, cracking in a stellate manner; asci cylindrical; sporidia elliptic or obovate, with many guttæ, then septate or fenestrate.

Stictis lichenicola—Mont., "Ann. Sc. Nat.," 1836, p. 281, t. 13, f. 3; Berk., "Ann. Nat. Hist.," No. 166; Cooke, "Handbk.," No. 2224; Phil. and Plow., "Grevillea," iv. p. 123.

On *Cladonia pyxidata.*

Mr. Berkeley expressed his doubt whether this was a

true fungus many years ago, since which time little or no light has been thrown upon its affinity.

Name—*Lichen*, a lichen, *colo*, to inhabit.

Wareham (Rev. M. J. Berkeley). Isle of Skye (Mr. C. Babington). Ireland!

2. *Stictis pallida*. Pers.

Scattered or gregarious, sometimes two or more coalescent, immersed, elliptic or circular; hymenium yellowish; mouth at first connivent, then open; asci clavate; sporidia 8, elliptic or subclavate, hyaline, 3 to 5 pseudo-septate, 14—17 × 5—6μ; paraphyses filiform, slender, adherent. (Plate XII. fig. 75.)

Stictis pallida—Pers., "Obs.," ii. p. 74, t. 6, f. 7; "Myco. Eur.," i. p. 338; Fries, "Sys. Myco.," ii. p. 196; "Summa Veg. Scan.," p. 373; "Eng. Flo.," v. p. 213; Karst., "Myco. Fenn.," p. 243; Cooke, "Handbk.," No. 2221; Pat., p. 212, f. 490. *Cryptodiscus pallidus*—Corda., "Icon. Fung.," ii. p. 37, t. 15, f. 129.

Exs.—Fries, "Scl. Suec.," No. 275; Karst., "Fung. Fenn.," 262.

On decorticated wood.

In an authentic specimen in Fries's "Scl. Suec.," No. 275, the receptacles are mostly elliptic, $\frac{1}{4}$ to $\frac{1}{2}$ a line long; the wood immediately surrounding them is whitish.

Name—*Pallidus*, pale.

Appin (Carmichael).

3. *Stictis microstoma*. Carm.

Very minute, punctiform, prominent, blackish, opening with a minute round or subelliptic orifice; asci cylindraceo-clavate; sporidia 8, oblong-elliptic, 3-septate, hyaline, granular within, 13—15 × 3μ; paraphyses filiform, branched.

Stictis microstoma—Carm., "Eng. Flo.," v. p. 213; Berk., "Outl.," p. 375; Cooke, "Handbk.," No. 2222.

On wood.

Scattered, at first nearly white, with a minute orifice, round which it gradually assumes a darker hue, and at

length, under a high magnifier, appears, when moist, of a subolivaceous black, resembling a minute *Sphæria* (M. J. Berkeley). Mouth 200 to 400μ broad; the disc when moistened is pale yellowish brown.

Name—μικρός, small, στόμα, the mouth; from the small mouth.

Appin (Capt. Carmichael).

B. SPORIDIA CLAVATE.

4. *Stictis pteridina.* Phil. and Buck.

Scattered, slightly immersed, circular or elongated, irregular, open; hymenium pallid-brown, not deeply depressed; margin membranaceous; asci broadly clavate; sporidia 8, biseriate, clavate or clavate-fusiform, 6 to 7 times pseudo-septate or muriform, 28—44 × 5—9μ; paraphyses filiform, adherent.

Stictis pteridina—Phil. and Buck. in Bucknall's "Fung. Bristol," pt. vi. p. 5, t. 1, f. 6.

On stems of *Pteris aquilina.*

Name—*Pteris,* the genus of ferns on one of which it grows.

Near Bristol! (Mr. Cedric Bucknall).

C. SPORIDIA FUSIFORM.

5. *Stictis hysterioides.* Desm.

Immersed, closed, hysteriform, then erumpent, prominent, open, ovate-oblong or suborbicular; border brown-black, subgranulate; hymenium waxy, tawny or rufus; asci cylindraceo-clavate; sporidia 8, oblong, obtuse or fusiform, with 4 guttæ, 16 × 3—4μ; paraphyses filiform.

Stictis hysterioides—Desm., "Ann. Sc. Nat.," 1843, p. 365; B. and Br., "Ann. Nat. Hist.," No. 314; Cooke, "Handbk.," No. 2225. *Propolis hysterioides*—Fckl., "Symb. Myco.," p. 255.

Exs.—Berk., No. 308; Moug. and Nest., No. 1242; Roumg., "Stirpes," 337.

On dead leaves of *Carices.*

Name—*Hysterium*, a genus of fungi, εἶδος, likeness; like a *Hysterium*.

Thame (Dr. Ayres). Rudloe, Wiltshire (Mr. C. E. Broome).

6. *Stictis seriata*. Lib.

Innate, punctiform, orbicular, plane or but slightly concave, disposed in approximate series, rubro-fuscous; asci linear-fusiform or subclavate; sporidia minute, oblong or fusiform (?); paraphyses filiform, slender, adherent.

Stictis seriata—Lib., "Crypt. Ard.," fasc. iii. No. 233; Phil. and Plow., "Grevillea," iv. p. 233. *Nævia seriata*—Fckl., "Symb. Myco.," p. 249.

Exs.—Lib., *l. c.*; Fckl., "F. Rh.," 1841; Phil., "Elv. Brit.," No. 100; Rabh., "Fung. Eur.," 1710 and 1909.

On *Carex ampullacea*.

Receptacles about 150 to 200μ, covering the leaves on the under side. This species is easily recognized, but after repeated searches I am not able to detect the sporidia. Fuckel says, "sporidia 6 to 8, globosa, minuta, hyalina includentibus." The asci are about 250 × 6μ. I am not sure that it should remain amongst the *Sticte*i; it is very near *Phacidium*.

Name—*Series*, a row; from growing in a row.

Forres, N.B.! (Rev. Dr. Keith).

7. *Stictis Fagicola* (nov. sp.).

Gregarious or scattered, immersed, urceolate, yellow; mouth connivent, nearly round or somewhat elliptic, surrounded by a spurious border of the same colour; asci cylindrical, slender; sporidia 8, fusiform, straight, simple, 8 × 2μ; paraphyses filiform, globose at the apices.

On beech—fallen, dead, decorticated branches.

About ¼ to ½ a line broad. Exactly resembling externally the next species, but having different asci, sporidia, and paraphyses.

Name—*Fagus*, the beech, *colo*, to inhabit.

Ellesmere, Salop!

8. *Stictis punctiformis.* Pers.

Gregarious, minute, immersed, urceolate, suborbicular; hymenium reddish-brown or fuliginous; mouth connivent, surrounded by a border of the same colour; asci cylindraceo-clavate; sporidia 8, fusiform, simple; paraphyses filiform, globose at the apices.

Stictis punctiformis—Pers. in Gay's collection in Kew Herbarium, named by Persoon himself, with which the English specimen has been compared.

On dead willow-wood.

Cups 100 to 500μ broad. Very similar to *S. Fagicola*; but the sporidia are simple, and the paraphyses are globose at the apices.

Name—*Punctum*, a point, *forma*, shape.

King's Lynn! (Mr. C. B. Plowright).

D. SPORIDIA DOUBTFUL.

9. *Stictis graminum.* Desm.

Orbicular, scattered, small, deeply excavated; disc black; margin prominent, clad with a white meal, nearly entire; asci elongated; sporidia (very minute, globose).

Stictis graminum—Desm., "Crypt. Fr.," exs. No. 1071; "Ann. Sc. Nat." (1840), xiii. 185; B. and Br., "Ann. Nat. Hist.," 1328; Fckl., "Sys. Myco.," p. 250; "Grevillea," i. p. 132; Gill., "Champ.," p. 179; Pat., p. 30, f. 69 (?).

Exs.—Desm., "Crypt. Fr.," 1071; Fckl., "F. Rh.," 1106.

On *Carex paniculata.* June.

Desmazieres describes the sporidia as "very minute, globose;" Fuckel as "filiform, as long as the ascus." Not having seen the British plant, we cannot determine the form of sporidia (Cooke, *l. c.*).

Rejected Species.

Stictis parallela, Fries, is a *Xylographa* (*vide* Leighton's "Lichen Flora of Great Britain").

Stictis longa, Fries, is a *Xylographa.*

Order VIII.—PHACIDIACEÆ.

Receptacle immersed, more or less coriaceous; hymenium at first covered, at length exposed by the regular or irregular fissure of the outer covering. (Plate XII. figs. 76–78.)

Name—From the typical genus *Phacidium.*

ARRANGEMENT OF THE GENERA.

I. *Phacidium.* Fries.
II. *Trochila.* Fries.
III. *Stegia.* Fries.

KEY TO THE GENERA.

Hymenium becoming exposed by the epidermis of the matrix splitting from the centre into laciniæ	*Phacidium.*
Hymenium becoming exposed by splitting at the summit irregularly	*Trochila.*
Hymenium becoming exposed by the falling off of a horizontal operculum	*Stegia.*

GENUS I.—PHACIDIUM. Fries.

Perithecium orbicular, flattened, subdimidiate, dehiscing from the centre into laciniæ, distinct from the placentiform disc. (Plate XII. fig. 76.)

The perithecium is covered by the epidermis of the matrix; the hymenium is mostly dark-coloured, lining the base of the perithecium.

On leaves and bark.

Name—φακός, a lentil, εἶδος, resemblance; shaped like a lentil.

ARRANGEMENT OF THE SPECIES.

A. Sporidia elliptic or subelliptic.		
(*a*) Brown	species	1
(*b*) Hyaline	„	2–6
B. Sporidia fusiform or subfusiform ..	„	7–10
C. Sporidia filiform or subfiliform	„	11–16

KEY TO THE SPECIES.

	On trees and shrubs	1
	On herbaceous plants	4
1	On the stems	2
	On the leaves	3

2.	Hymenium brownish or cinereous: on *Rubus* ..	*striatum.*
	Hymenium pale fuliginous: on *Pinus*	*Pini.*
	Hymenium straw-coloured: on *Vaccinium*	*leptideum.*
3.	Hymenium dirty-yellow: on *Quercus*	*dentatum.*
	Hymenium pallid, livid, or yellowish: on *Quercus*	*coronatum.*
	Hymenium whitish: on *Rubus*	*Rubi.*
	Hymenium whitish: on *Ilex*	*Ilicis.*
	Hymenium whitish: on *Quercus*	*minutissimum.*
	Hymenium sooty-black: on *Vaccinium*	*Vaccinii.*
	Hymenium pale brown: on *Arctostaphylos*	*Arctostaphyli.*
	Hymenium cinereous: on *Pinus*	*abietinum.*
	Hymenium black: on *Juniperus*	*tetrasporum.*
4.	On the stems	5
	On the leaves	6
5.	Hymenium fuliginous: on *Campanula* ..	*radians.*
	Hymenium red-brown: on *Clinopodium* ..	*simulatum.*
6.	Hymenium brownish or cinereous: on *Caltha*	*Calthæ.*
	Hymenium dingy-brown: on various plants	*repandum.*

A. SPORIDIA ELLIPTIC OR SUBELLIPTIC.

(*a*) *Brown.*

1. *Phacidium tetrasporum.* Phil. and Keith.

Epiphyllous, erumpent, circular or oblong, convex, cinereous, seated on a brownish-yellow spot, splitting irregularly into 3 or 4 laciniæ; hymenium black on the surface, brownish-yellow within; asci broadly clavate; sporidia 4, elliptic-ovate, with a septum near the lower end, often with a papilla, brown, 25—28 × 17μ; paraphyses numerous, filiform, with brown, pear-shaped heads, septate.

Phacidium tetrasporum—Phil. and Keith. in *Gard. Chron.*, 1880, Sept. 4, t. 56; "Scott. Nat.," vi. 164.

On the upper side of juniper-leaves while yet green, simulating a *Puccinea.*

About ½ a line broad.

Name τετράς, four, σπόρος, seed; four-seeded.

Forres, N.B.! (Rev. Dr. Keith).

(*b*) *Hyaline.*

2. *Phacidium radians.* Rob.

Erumpent, black; receptacles minute, rounded or oblong, globose, then flattened, solitary and scattered, or

confluent in radiating lines; hymenium fuliginous; asci clavate; sporidia 8, oblong-elliptic or obovate, straight or slightly curved, 7–10 × 3μ; paraphyses filiform, slender.

Phacidium radians—Rob. in Desm., "Crypt. Fr."; Desm., "Ann. Sc. Nat.," 1842, p. 116; Karst., "Symb.," p. 257; Cooke, "Grevillea," ii. p. 165; Kickx., "Flo. Flan.," i. p. 459; Gill., "Champ.," p. 168. *Trochila radians*—De Not., "Disc.," p. 16. *Leptotrochila radians*—Karst., "Myco. Fenn.," p. 245.

Exs.—Desm., "Crypt. Fr.," ed. i. 1350, and ed. ii. 750; Karst., "Fung. Fenn.," 845.

On living leaves of *Campanula patula*.

Name—*Radius*, a sunbeam; from growing in radiating lines.

Near Worcester (Mr. Edwin Lees).

3. *Phacidium minutissimum*. Awd.

Hypophyllous, gregarious, minute, innate, round or angular, brown, soon splitting from the centre into 3 to 4 laciniæ, exposing the whitish hymenium; asci minute, clavate; sporidia 8, elliptic, 7 × 4μ; paraphyses filiform, scarce.

Phacidium minutissimum—Awd. in Rabh., "Fung. Eur.," 228; Fckl., "Symb. Myco.," p. 263; Cooke, "Handbk.," No. 2267; Sacc., "Mich.," vol. ii. p. 537; Fresen., "Beitr.," t. viii. f. 17–19; Gill., "Champ.," p. 167, c. i.

Exs.—Rabh., "Fung. Eur.," 228; Fckl., "F. Rh.," 1098.

About 100 to 150μ broad.

On oak-leaves.

Name—*Minutus*, minute; very minute.

Shere! (Dr. Capron).

4. *Phacidium Vaccinii*. Fries.

Erumpent, minute, convex, shining, rugose, splitting into 4 laciniæ; hymenium sooty black; asci broadly clavate; sporidia 8, oblong-elliptic, 10 × 4μ; paraphyses filiform, slender.

Spermogonia: spermatia simple, cylindrical, straight obtuse, 10—13 × 2—2·5μ.

Phacidium Vaccinii—Fries, "Sys. Myco.," ii. p. 575; Berk., "Eng. Flo.," v. p. 292; Cooke, "Handbk.," 2264; Fckl., "Symb. Myco.," p. 261; Gill., "Champ.," p. 170. *Xyloma erumpens*—Fries, "Obs.," i. p. 202.

Exs.—Fries, "Scl. Suec.," 289; Fckl., "F. Rh.," 1029.

On leaves of *Vaccinium Vitis Idæa*.

Name—*Vaccinium*, the generic name of the plant on which it grows.

Near Berwick (Dr. Johnston). Stiperstones, Salop!

5. *Phacidium simulatum*. B. and Br.

Erumpent, linear, cup-shaped, margin irregular; hymenium linear, red-brown; asci cylindraceo-clavate, sporidia 8, obovate, 2-guttulate, $10 \times 4{\cdot}5\mu$; paraphyses filiform, enlarged at the apices.

Phacidium simulatum—B. and Br., in "Ann. Nat Hist.," No. 967, t. 16, f. 20; Cooke, "Handbk.," No. 2273.

On dead stems of *Clinopodium*.

Name—*Simulo*, to counterfeit; resembling another.

Langridge, Somerset! (Mr. C. E. Broome).

6. *Phacidium Ilicis*. Lib.

Subinnate, convex, black, dehiscing into 3 to 5 laciniæ, hymenium whitish; asci clavate; sporidia 8, narrowly elliptic, 2-guttulate, $10 \times 3{\cdot}5\mu$; paraphyses filiform, stout.

Stylospores: stroma containing 3 to 5 cells, orbicular, plane, black, shining, penetrating the matrix, splitting into 3 to 5 laciniæ; stylospores cylindrical, straight, $13 \times 2\mu$.

Phacidium Ilicis—Lib., Exs. No. 64; Fresen., "Beitr.," t. 8, f. 17–21; Tul., "Select. Fung. Carp.," iii. p. 138, t. 15, f. 1–8; Cooke, "Handbk.," 2272; Gill., "Champ.," p. 166. *Phacidium multivalve*—Fries, "Sys. Myco.," ii. p. 576; *Sphæria bifrons*—Sow., t. 316.

Stylosporous stage: *Ceuthospora phacidioides*—Grev., t. 253; Berk., "Eng. Flo.," v. p. 283. *Cytispora foliicola*—Lib., exs. No. 64.

Exs.—Moug. and Nest., 560; Desm., No. 1626; Cooke, "Fung. Brit.," ed. ii. 450.

On dead holly-leaves.
Name—*Ilex*, holly; growing on holly.
Common!

B. SPORIDIA FUSIFORM OR SUBFUSIFORM.

7. *Phacidium Calthæ*. Phil.

Hypophyllous, congregated or confluent on brown spots, innate, then erumpent; hymenium plane or convex, brownish or cinereous; asci broadly clavate; sporidia 8, oblong-fusiform or subclavate, 2-guttulate, 15—20 × 5—7μ; paraphyses filiform, occasionally forked at the apices.

Phacidium Calthæ—Phil. in "Grevillea," viii. p. 103.
On decaying leaves of *Caltha palustris*. Autumn.
About ½ to ¾ of a line broad. The epidermis of the leaf forms an indistinct margin, or altogether disappears, leaving the disc exposed.
Name—*Caltha*, the generic name of the plant on which it grows.
Scotland! (Rev. J. Stevenson). Ruyton-of-the-Eleven-Towns, Salop!

8. *Phacidium Arctostaphyli*. Karst.

Subgregarious, innate, then erumpent, splitting the epidermis into about five equal, acute, spreading laciniæ; hymenium convex, pale brown, when dry black; asci clavate; sporidia 8, elongate-fusiform or oblong-fusiform, straight or curved, with two large guttæ, 18—22 × 4—5μ; paraphyses filiform, coherent, becoming brown at the apices.

Phacidium Arctostaphyli—Karst., "Symb.," p. 256. *Propolis phacidioides*—Fries, "Summa Veg. Scan.," p. 372. *Stictis phacidioides*—Fries, "Sys. Myco.," ii. p. 198; Berk., "Ann. Nat. Hist.," 162; Cooke, "Handbk.," 2231. *Sphæria arbuti*—Sow., t. 370, f. 6. *Trochila phacidioides*—Karst., "Myco. Fenn.," p. 249.
Exs.—Fries, "Scl. Suec.," 297; Karst., "Fung. Fenn.," 843.
On leaves of *Arctostaphylos Uva-Ursa*.

Name—From the plant on which it grows.

Lubcroy, Sutherlandshire (Mr. C. Babington).

9. *Phacidium abietinum.* Schmidt.

Erumpent, subrotund, convex, then depressed, black, splitting into 3 to 4 obtuse laciniæ; hymenium cinereous; asci cylindraceo-clavate; sporidia 8, oblong-fusiform, 10—14 × 4·5μ; paraphyses filiform, slender.

Phacidium abietinum—Schmidt in "Myco. Heft.," i. p. 35; Fries, "Sys. Myco.," ii. p. 576; Fckl., "Symb. Myco.," p. 262; Cooke, "Handbk.," No. 2268; Gill., "Champ.," p. 165.

Exs.—Roumg., "Fung. Gal.," 659.

On fallen leaves of Scotch pine.

Orbicular, ½ a line broad.

Name—*Abies*, the generic name of the tree on which it was first found.

Scotland (A. Jerdon). Carlisle (Dr. Carlyle).

10. *Phacidium striatum.* Phil. and Plow.

Scattered, orbicular, rugose-striate, splitting into 5 to 6 laciniæ; hymenium fuliginous; asci clavate, attenuated towards the summit; sporidia 8, lanceolate, simple or 1-septate, 25—30 × 2—4μ; paraphyses filiform, curved at the apices, numerous. (Plate XII. fig. 76.)

Phacidium striatum—Phil. and Plow. in "Grevillea," xiii. p. 75.

On dead stems of *Rubus*.

About ½ a line broad; resembling externally *P. rugosum*, Fries, but with totally different sporidia.

Name—*Stria*, a furrow; marked with lines.

Dinmore, Herefordshire! (Mr. C. B. Plowright).

C. SPORIDIA FILIFORM OR SUBFILIFORM.

11. *Phacidium Pini.* (A. and S.)

Scattered or crowded, erumpent, subrotund, hemispherical, depressed, at first closed, shining, black, at length splitting into obtuse laciniæ; hymenium pale fuliginous; asci cylindraceo-clavate; sporidia 8, filiform,

acute at the ends, 5 to 9 pseudo-septate, 80 × 4μ; paraphyses filiform, simple, clavate at the apices, adherent.

Spermogonia intermixed with the above, punctiform, black, acutely umbonate; cavity simple, sinuose, narrow; spermatia filiform, slightly bent, about 10 × 1μ.

Xyloma Pini—A. and S., "Consp.," p. 60, t. 5, f. 8. *Phacidium Pini*—Fries, "Sys. Myco.," ii. p. 573; "Eng. Flo.," v. p. 292; Curr., "Linn. Trans.," xxiv. t. 25, f. 36; Cooke, "Handbk.," No. 2262; Tul., "Select. Fung. Carp.," iii. p. 136; Fckl., "Symb. Myco.," p. 263, t. iv. f. 31. *Phacidium valvatum*—Schmidt, "Myco. Heft.," i. p. 30, t. 2, f. 11. *Coccomyces Pini*—Karst., "Myco. Fenn.," p. 254.

Exs.—Fries, "Scl. Suec.," 62; Fckl., 1095; Roumg., "Fung. Gal.," 1268.

On bark of *Pinus sylvestris*.

Name—*Pinus*, the generic name of the tree on which it grows.

Common!

12. *Phacidium dentatum*. Schmidt.

Orbicular or subquadrate, plane, depressed in the centre, shining, black, seated on pallid spots, at length splitting into 4 or 5 acute laciniæ; hymenium dirty-yellow, somewhat livid; asci cylindraceo-clavate; sporidia 8, filiform, 80 × 2·5μ; paraphyses filiform.

Phacidium dentatum—Schmidt, "Myco. Heft.," i. 147; Fries, "Sys. Myco.," p. 577; Berk., "Eng. Flo.," v. p. 292; Fckl., "Symb. Myco.," p. 261; Corda, "Icon.," iii. f. 81; Tul., "Select. Fung. Carp.," iii. p. 132; Cooke, "Handbk.," No. 2266; Gill., "Champ.," p. 166, c. i.

Exs.—Moug. and Nest., No. 561; Schmidt, No. 206; Fckl., "F. Rh.," No. 1090; Ayres, No. 71; Berk., No. 93; Cooke, "Fung. Brit.," 458, ed. ii. 449; Roumg., "Fung. Gal.," 68; Rav., "Fung. Am.," 318.

On fallen oak-leaves.

About ¼ of a line broad.

Name—*Dens*, a tooth; toothed.

Common!

13. *Phacidium Rubi.* Fries.

Innate, roundish, hemispherical or plane, rugulose, black; splitting into obtuse, unequal laciniæ; disc whitish; paraphyses curved at the tips; sporidia linear, rounded at the ends with 6 to 8 nuclei.

Phacidium Rubi—Fries, "Sys. Myco.," ii. p. 578; B. and Br., "Ann. Nat. Hist.," No. 586; Cooke, "Handbk.," No. 2274.

Exs.—Fries, "Scl. Suec.," No. 56; Rabh., "Fung. Eur.," No. 1028.

On dead bramble-stems. Fries says "on leaves of *Rubus Idæus*." Gregarious, generally confluent, form and size variable, 1 to 2 lines broad, when fresh shining, when dry opaque.

"The asci, paraphyses, and sporidia are just the same as in *P. coronatum*" (B. and Br., *l. c.*).

Twycross, Warwickshire (Rev. A. Bloxam).

14. *Phacidium coronatum.* Fries

Gregarious, often confluent, innate-emergent, orbicular, hemispherical-depressed, at first closed, when moist tumid, convex, smooth, shining, black, when dry collapsed. rugose, often umbonate, at length splitting into 5 to 10 acute, nearly equal laciniæ; hymenium pallid, livid, or yellowish; asci cylindraceo-clavate, attenuated at the summit; sporidia 8, fusoideo-filiform, straight or curved, pseudo-multiseptate, 45—70 × 2—3μ; paraphyses numerous, filiform, simple, adherent, flexuous or circinate at the apices.

Spermogonia intermixed with the above, punctiform, globose-depressed, unilocular, filled with spermatia, which are elongated, straight, colourless, about 65μ long.

Phacidium coronatum—Fries, "Obs.," i. p. 167; in "Vet. Ac. Handl.," 1819, p. 108; "Sys. Myco.," ii. p. 577; "Summa Veg. Scan.," p. 370; Berk., "Eng. Flo.," v. p. 292; Ditm. in Sturm., "Flo.," pt. iii. (1817), p. 127, t. lxiii.; Grev., t. 52; Berk., "Mag. Zool. and Bot.," vol. i. No. 58, t. 15, f. 5; Corda, "Icon.," iii. p. 31, t. 5, f. 81;

Curr., "Trans. Linn. Soc.," vol. xxiv. (1863), p. 155, t. xxv. f. 7; Tul., "Select. Fung. Carp.," iii. p. 134; Cooke, "Handbk.," No. 2265; Karst., "Myco. Fenn.," p. 256; Fckl., "Symb. Myco.," p. 261. *Peziza viridis*—Bolt., 109.

Exs.—Fries, 163; Schm., 82; Moug. and Nest., 559; Desm., "Crypt. Gal.," fasc. 12, No. 570; Rabh., "Herb. Myco.," 716; Rabh., "Fung. Eur.," 652; Cooke, "Fung. Brit.," 457; Fckl., "F. Rh.," 1096; Karst., "Fung. Fenn.," 340; Phil., "Elv. Brit.," 201; Winter, "Fungi Eur.," 2645.

On fallen leaves of oak, poplar, willow, etc.

About ½ to 1 line broad.

Name—*Corona*, a crown; crowned with a ring of laciniæ.

Common!

15. *Phacidium leptideum.* Fries.

Somewhat innate, depressed, plane, black, splitting into several acute laciniæ; hymenium straw-coloured; sporidia 8, filiform, curved, hyaline, 86 × 3—4μ.

Phacidium leptideum—Fries, "Sys. Myco.," ii. p. 576; and "Summa Veg. Scan.," p. 370; B. and Br., "Ann. Nat. Hist.," No. 1830; "Grevillea," viii. p. 9. *Phacidium quadratum*—Schmidt., "Myco. Heft.," p. 32; Wallr., "Flo. Germ.," ii. p. 415. *Coccomyces quadratus*—Karst., "Myco. Fenn.," p. 255.

Exs.—Karst., "Fung. Fenn.," 848; Roumg., "Fung. Gal.," 543.

On stems of *Vaccinium myrtillus.*

Cups ½ to 1 line broad; asci cylindraceo-clavate, attenuated at the apices, 50 × 16μ; sporidia 60—90 × 2·5μ (Karst., *l.c.*).

Name—λεπτος, fine, εἶδος, appearance; a fine species.

Scotland.

16. *Phacidium repandum.* Fries.

Gregarious, innate, subrotund, pallid-green, at length black, splitting into unequal, obtuse laciniæ; hymenium dingy-brown; asci cylindraceo-clavate; sporidia 8,

acicular, straight or very slightly bent, 11—12 × 3μ; paraphyses filiform.

Phacidium repandum—Fries in "Vet. Ac. Handl.," 1819, p. 108; "Sys. Myco.," ii. p. 578; "Eng. Flo.," v. p. 293; Berk., "Outl.," 379; Cooke. "Handbk.," No. 2269; Gill., "Champ.," p. 169. *Xyloma herbarum*—A. and S., "Consp.," p. 65, t. 14, f. 6. *Leptotrochila repandum*—Karst., "Myco. Fenn.," p. 246.

Exs.—Desm., "Crypt. Fr.," ed. ii. 1640; Cooke, "Fung. Brit." 283; Rehm, "Asco.," 321; Roumg., "Fung. Gal.," 835.

On stems and leaves of various plants.

Name—*Repandus*, bowed; the laciniæ bent back.

Common!

Rejected Species.

Phacidium carbonaceum, Fries, is *Discella carbonacea* (Fries)—B. and Br., *vide* "Ann. Nat. Hist.," No, 426, t. xii. f. 8.

GENUS II.—TROCHILA. Fries, "Summa Veg. Scan.," p. 367.

Receptacle innate, at first closed, covered by the epidermis, membranaceous, subcoriaceous, erumpent, then splitting at the top irregularly. (Plate XII. fig. 77.)

Name—τροχίλος, a hollow running round the base of a column; raised in the centre, surrounded by a depression.

1. *Trochila craterium.* Fries.

Hypophyllous, scattered, blackish, at length deeply collapsed; asci cylindrical; sporidia very shortly oval, almost round, sometimes with a large gutta, 7·5μ long.

Pycnidia: Stylospores minute, subglobose. (Plate XII. fig. 77.)

Trochila craterium—Fries, "Summa Veg. Scan.," p. 367; Berk., "Outl.," 381; Fckl., "Symb. Myco.," p. 277;

Cooke, "Handbk.," No. 2316; Tul., "Select, Fung. Carp.," ii. p. 180. *Sphæria craterium*—"Eng. Flo.," v. p. 277. *Cryptosphæria punctiformis*, var. *β. Hederæ*—Grev., "Flo. Edin.," p. 362; Pers., "Syn. Fung.," p. 90.

Pycnidia: *Myxosporium paradoxum*—De Not., "Micro. Ital.," Dec. ii. f. 10. B. and Br., "Ann. Nat. Hist.," No. 439. *Glœosporium Notarisii*—Mont., "Ann. Sc. Nat.," 1849, xii. 296; Fckl., "Symb. Myco.," p. 277; Rehm, "Asco.," 719.

Exs.—Fckl., "F. Rh.," 1113 and 1649; Baxt., 29; Ayres, 65; Moug. and Nest., 986; Rabh., "Fung. Eur.," 527 and 1720; Cooke, "Fung. Brit.," 180, ed. ii. 294; Roumg., "Stirpēs," 169.

On dead ivy leaves.

Name—*Cratera*, a cup or goblet; from its supposed resemblance to a cup.

Common!

2. *Trochila Buxi*. Capron.

Hypophyllous, blackish, cæspitose or scattered, splitting into minute unequal laciniæ; sporidia oval, elongated, 10—12μ (E. Capron).

Trochila Buxi—Capron in Cooke's "Handbk.," No. 2315.

On box-leaves.

Sporidia larger than in *T. craterium*.

Name—*Buxus*, the generic name of the box-tree, on which it grows.

Shere (Dr. Capron).

3. *Trochila Lauro-cerasi*. (Desm.)

Hypophyllous, orbicular, punctiform, hollow when collapsed, at length black, splitting into three acute laciniæ; asci cylindrical or cylindraceo-clavate; sporidia 8, oblong, rounded at the ends, 8—12 × 5μ.

Phacidium Lauro-cerasi—Desm., "Crypt. Fr.," exs., 188; Berk., "Eng. Flo.," v. p. 293; Fries, "Elench.," ii. p. 136; Gill., "Champ.," p. 166, c. i. *Trochila Lauro-cerasi*—Fries, "Summa Veg. Scan.," p. 367; Berk., "Outl.,"

381; Fckl., "Symb. Myco.," p. 277; Cooke, "Handbk.," No. 2314; Tul., "Select. Fung. Carp.," p. 181; Sacc., "Mich.," vi. p. 83.

Exs.—Desm., "Crypt. Fr.," 188; Moug. and Nest., 985; Ayres, No. 72; Berk., 45; Cooke, "Fung. Brit.," 179, ed. ii. 295; Fckl., "F. Rh.," 1112; Roumg., "Fung. Gal.," 67 and 266; Sacc., "Mich.," vi. p. 83; Winter, "Fungi Eur.," 2739; Rehm, "Asco.," 622.

On fallen laurel-leaves.

Disc yellowish when moist.

Name—The specific name of laurel (*Cerasus Laurocerasus*) on which it grows.

Common!

Genus III.—Stegia. Fries.

Perithecia orbicular, splitting horizontally; operculum deciduous (Berk.). (Plate XII. fig. 78.)

Name—στέγω, to cover; the hymenium being covered by the perithecium.

Stegia ilicis. Fries.

Innate, operculum nearly plane, falling off, surrounded by a ring-like, whitish margin; asci linear; sporidia oblong, $12 \times 4\mu$. (Plate XII. fig. 78.)

Stegia ilicis—Fries, "Elench.," ii. p. 112; Cooke, "Handbk.," No. 2313; Gill., "Champ.," p. 172. *Eustegia ilicis*—"Eng. Flo.," v. p. 280; Fckl., "Symb. Myco.," p. 264. *Sphaer. concava*—Sow., t. 317. *Xyloma concava*—Grev., "Flo. Edin.," p. 368.

Exs.—Fries, "Scl. Suec.," No. 417; Moug. and Nest., No. 82; Baxt., No. 77; Fckl., "F. Rh.," 1589; Cooke, "Fung. Brit.," No. 178, ed. ii. No. 293; Klotzsch, 431; Rabh., "Fung. Eur.," No. 463.

On holly-leaves.

Name—*Ilex*, the generic name of the tree on which it grows.

Common!

Order IX.—GYMNOASCEÆ. Sadebeck.

Without a receptacle, or an indication of one only in the more highly developed genera; asci either single or in little tufts, arising from widely creeping hyphæ; or more or less closely crowded together into hymenia; or, lastly, arising from the terminal branches of copiously ramifying hyphæ in pellets, which are covered with a lax mycelial veil.

Name—γυμνος, naked, ἀσκός, a leather bottle; here

Genus I.—Ascomyces. Mont. et Desm., "Ann. Sc. Nat.," ser. 3, vol. xi. p. 345 (1849)

Parasitic on living plants; asci not seated on a proper receptacle, but on the cuticle of the host-plant, closely pressed together in little tufts or extended layers, arising from the mycelium, which ramifies between the epidermal cells and the cuticle. Their effect is to cause the injured parts to change colour, to swell into blisters, and become much enlarged. The asci are very small, cylindrical, clavate, or subpyriform, and contain 8 (or more?) sporidia. (Plate XII. fig. 79.)

Name—ἀσκός, ascus, μύκης, a fungus; fungi consisting of asci only.

Arrangement of the Species.

A. Perennial mycelium spreading through the intercellular spaces of the young shoots in spring.
- (a) Asci furnished with a stem-cell .. species 1–3
- (b) Asci not furnished with a stem-cell „ 4

* Professor Sadebeck has contributed a revision of this order to Dr. Winter's new edition of Rabenhorst's "Cryptogamin-Flora von Deutschland," the arrangement of which is followed here as regards the genus *Ascomyces*. The order is not included in the *Discomycetes* in the work quoted.

B. The mycelium spreading *only* between the epidermal cells and the cuticle of the young shoots.
  (*a*) Asci furnished with a stem-cell .. species 5–7
C. Species the position of which is at present uncertain .. .. „ 8, 9

KEY TO THE SPECIES.

	On trees	1
	On herbaceous plants..	2
1.	On leaves of *Alnus glutinosus*: sporidia 8	*Tosquinetii.*
	On female catkins of *Alnus glutinosus*: sporidia more than 8	*Alni.*
	On leaves of *Juglans regia*	*Juglandis.*
	On branches and leaves of *Betula alba*	*turgidus.*
	On leaves of *Pyrus communis, Cratægus Oxycantha,* and *C. monogynea*	*bullatus.*
	On young fruit of *Prunus domestica, P. Padus,* and *P. spinosa*	*Pruni.*
	On leaves and branches of *Prunus avium, P. Cerasus, P. domestica, P. Chamæcerasus,* and *Persica vulgaris, P. amygdalus,* and *P. communis*	*deformans.*
2.	On *Potentilla Tormentilla*	*Potentillæ.*
	On *Trientalis Europæa*	*Trientaltis.*

A. PERENNIAL MYCELIUM SPREADING THROUGH THE INTERCELLULAR SPACES OF THE YOUNG SHOOTS OF THE INFECTED PLANT IN SPRING.

(*a*) *Asci furnished with a stem-cell.*

1. *Ascomyces Pruni.* (Tul.)

On unripe fruit of *Prunus domestica, spinosa,* and *Padus,* deforming them; asci oblong-clavate, rounded or truncate at the summit; sporidia 8, broadly elliptic, about 6 × 4μ.

Taphrina Pruni—Tul. in "Ann. Sc. Nat.," ser. 5, vol. v. p. 129; Johanson, "Vet. Ac. Handl.," arg. 42, p. 32. *Exoascus Pruni*—Fckl., "Symb. Myco.," p. 252; Sadebeck in Rabh., "Krypt. Flo.," p. 5, fig. 3. *Ascomyces Pruni*—B. and Br., "Ann. Nat. Hist.," No. 1629; "Grevillea," v. p. 62.

Exs.—Fckl., "F. Rh.," 1081; Kunze, "Fung. Sel.," 167; Rabh., "Fung. Eur.," 1167; Rehm, "Asco.," 130; Thum., "Fung. Aus.," 504; Thum., "Mycoth. Univ.," 976.

On fruit of *Prunus Padus*, *P. domestica*, and *P. spinosa*. June.

Name—From the host plant.

Bishop's Castle, Salop! Sibbertoft (Rev. M. J. Berkeley).

2. *Ascomyces deformans*. Berk.

Hypophyllous, rendering the matrix here and there bullate, sprinkled with a white powder; asci short, cylindrical; sporidia elliptic, hyaline, $7 \times 5\mu$.

Ascomyces deformans—Berk. in "Outl.," 376, t. i. f. 9, A, B; and "Crypt. Bot.," p. 284; Cooke, "Handbk.," No. 2233.

Exoascus deformans—Fckl., "Symb. Myco.," p. 252; Sadebeck in Rabh., "Crypt. Flo.," p. 6. *Taphrina deformans*—Tul., "Ann. Sc. Nat.," ser. 5, vol. v. p. 129. *Exoascus Wiesneri*—Rathey, "Oest. Bot. Zeit.," 1880, No. 7.

Exs.—Fckl., "F. Rh.," 2063 and 2275; Kunze, "Fung. Sel.," 168, 274; Winter, "Fungi Eur.," 2035: Rehm, "Asco.," 370.

On living leaves of peach. June.

Sadebeck says (*l. c.*) that this species produces the "witches' besoms" on *Prunus Avium*, *P. Cerasus*, *P. domestica*, and *P. Chamæcerasus*; also the so-called "curl" disease of *Persica vulgaris*, *P. Amygdalus*, and *P. communis*. Asci 42 to 50μ long, 5 to 7μ broad; the stem-cell 16μ or more high, 5μ, but mostly only 1·5 to 2μ, broad. Notwithstanding their pointed lower ends, the stem-cells do not force themselves between the epidermal cells, but are seated on them.

Name—*Deformo*, to deform.

3. *Ascomyces bullatus*. B. and Br.

Tufts punctiform, at length confluent, at first covered by the epidermis, which it raises in blisters; asci clavate; sporidia 8, ovate or elliptic, subgelatinous, hyaline.

Ascomyces bullatus—B. and Br. in Berk., "Outl.," p. 376; "Crypt. Bot.," p. 284; Cooke, "Handbk.,"

No. 2232; Gill., "Champ.," p. 201. *Oidium bullatum*—B. and Br., "Jour. Hort. Soc.," ix. p. 51, with fig. *Taphrina bullata*—Tul., "Ann. Sc. Nat.," ser. 5, vol. v. p. 127.; Johanson, "Vet. Ac. Handl.," 42, p. 33. *Exoascus bullatus*—Fckl. "Symb. Myco.," nacht. ii. p. 49; Sadebeck, *l. c.*

Exs.—Fckl., "F. Rh.," 2551; Thum., "Fung. Aus.," 972 and 1056.

On living pear-leaves. It also occurs on *Cratægus Oxycanthus*, and *C. monogyna*. April and May.

The asci are 30—37 × 8μ; the sporidia 4·5μ (Sadebeck, *l. c.*). Asci 15—25 × 10μ (Cooke, *l. c.*).

Name—*Bullata*, a blister; blistered.

Shrewsbury!

(*b*) *Asci not furnished with a stem-cell.*

4. *Ascomyces Potentillæ.* (Farlow.)

Decolorizing (to pale yellow-green) the branches and leaves, rendering the branches several times thicker than their natural size; asci clavate, rounded or truncate at the summit, attenuated below into a slender, non-septate stem, continuous with the mycelium, which spreads through the intercellular spaces of the epidermis; sporidia 8, oblong-elliptic, 5—8 × 4μ.

Exoascus deformans, var. *Potentillæ*—Farlow, "Proc. Am. Ac. A. and S.," xviii. (1883), p. 84. *Taphrina Tormentillæ*—Rost., "Bot. Tid.," ser. 3, vol. iv. (1884-1885), p. 239; Johanson, "Vet. Ac. Handl.," 42 (1885), p. 29, t. 1, f. 2.

On *Potentilla Tormentilla*, Scop.

The asci in the Scottish specimen are truncate or rounded at the summit, and attenuated downwards more or less equally to a slender stem-like base, arising directly from the branching hyphæ beneath the cuticle, 30 to 50μ high, 7 to 9μ in the broadest part, and 2μ in the narrowest part. The sporidia are confined to the broad upper half of the ascus, elliptic, and (as I measure them) 4—5 × 2—2·5μ.

Craigiebuckler Wood, Aberdeen! (Dr. James W. H. Trail).

B. THE MYCELIUM SPREADING ONLY BETWEEN THE EPIDERMAL CELLS AND THE CUTICLE.

(*a*) *Asci furnished with a stem-cell.*

5. *Ascomyces Tosquinetii.* West.

Producing blisters on the upper surface of the leaves; asci cylindrical or cylindraceo-clavate, round at the summit, truncate at the base; sporidia 8, spherical, 4—5μ broad.

Ascomyces Tosquinetii—West in "Bull. l'Acad. Belg.," ser. 2, vol. xi. p. 655; Phil. and Plow, "Grevillea," vi. p. 25; Gill., "Champ.," p. 201. *Exoascus Alni*—De Bary in Fckl., "Symb. Myco.," p. 252. *Taphrina alnitorqua*—Tul., "Ann. Sc. Nat.," ser. 5, vol. 5, p. 130. *Exoascus Tosquinetii*—Sacc., "Mich.," iv. p. 433.

Exs.—Fckl., "F. Rh.," 2276; Rehm's "Asco.," 217; Phil., "Elv. Brit.," 150; Rabh., "Fung. Eur.," 1837; Thum., "Fung. Aus.," 183; and "Mycoth. Univ.," 81.

On living leaves of *Alnus glutinosus.* July and August.

Name—After M. Tosquinet.

6. *Ascomyces Alni.* B. and Br.

Deforming the inflorescence; sporidia numerous in each ascus.

Ascomyces Alni—B. and Br., "Ann. Nat. Hist.," No. 1628; "Grevillea," v. p. 62; not *Exoascus Alni*—De Bary. *Exoascus alnitorqua,* form *Alni incanæ*—Kühn in Rabh., "Fung. Eur.," No. 1616. *Ascomyces Tosquinetii* (West)—Kunze, "Fung. Sel.," 369. *Exoascus Alni,* De Bary, form *strobilina*—Thum. in Rehm's "Asco.," 518.

Exs.—Rabh., "Fung. Eur.," 1616; Kunze, "Fung. Sel.," 369; Rehm, "Asco.," 518.

On female catkins of *Alnus glutinosus.*

Differs from other species in the asci containing more numerous sporidia, which are only ·0002 to ·0003 inch

(5 to 7·6μ) long, whereas in *A. bullatus* they are ·0004 inch (10μ) (B. and Br., *l. c.*).

Name—From the name of the host plant.

Dr. Masters.

7. *Ascomyces turgidus.* (Sadeb.)

Producing "nests," or "witches' besoms," on birch, developing the asci in spring and summer on the under side of the leaves, on which the leaves at first curl up sinuously, lose the fresh green colouring of the healthy leaf, and on the breaking forth of the asci appear to be covered on the under side with a greyish-white hoariness. The asci are 46—50μ long, and about 15μ broad: they have a stem-cell 16—17μ high, and 15μ broad; they, however, diminish conically downwards and penetrate between the epidermal cells. The sporidia are 3—4μ in diameter.

Exoascus turgidus—Sadeb. in Rab., "Crypt. Flo.," vol. vi p. 8.

On *Betula alba*, both on the large trees and small ones. From the end of May to the middle of August.

The occurrence of "witches' besoms" are by no means uncommon on birch in this country, and if they are produced by this fungus, as Professor Sadebeck asserts, the species must be recorded here.

C. SPECIES THE POSITION OF WHICH IS AT PRESENT UNCERTAIN.

8. *Ascomyces Juglandis.* Berk.

Hypophyllous, effused, snow-white on the nerves of the leaves; sporidia ovoid, hyaline.

Ascomyces Juglandis—Berk., "Outl.," p. 376; Cooke, "Handbk.," No. 2235. *Gymnosporium leucosporum*—Mont., "Syll.," p. 390.

On walnut-leaves, *Juglandis regia.*

Name—From the tree on which it grows.

9. *Ascomyces Trientalis.* Berk.

Spots orbicular or irregular, arising from a reddish stratum.

Ascomyces Trientalis—Berk. in Cooke's "Handbk.," No. 2234.

On *Trientalis Europæa.*

Name—From the host plant.

I am informed on very competent authority that nothing but *Tubercinia trientalis* is now to be found on Mr. Berkeley's original specimens, but this is no sufficient reason for suppressing the species, seeing with what difficulty specimens are preserved.

ADDENDA.

[By a provoking oversight, the following species and notes have been omitted.]

Mollisia (Niptera) Curreiana (nov. sp.).

Disc very dark bluish-grey, almost black, margined, round or irregular, not a line wide; excipulum composed of small, distinctly outlined cells; sporidia colourless, narrowly turbinate, elliptic or curved, 8—10 × 2μ.

Patellaria palustris—Currey in "Linn. Trans.," xxiv. p. 155, t. 25; B. and Br., "Ann. Nat. Hist.," No. 1080; Cooke, "Handbk.," No. 2173.

On dead rushes in water.

Cups $\frac{3}{4}$ of a line broad; hymenium plane, margin distinct; asci cylindraceo-clavate, about 55μ long by 5μ broad. In the original specimen the cups are seated on a sooty-black space having the appearance of a tapesium. They much resemble *Mollisia palustris* (Rob.) in size, colour, and consistence. [It should stand next to *M. epithallina*, p. 173.]

Paul's Cray! (Mr. Frederick Currey).

Lachnea (Scutellinia) setosa. (Nees.)

Gregarious, sessile, concave, orange-colour; clothed externally with long, erect, brown hairs; asci cylindrical; sporidia 8, narrowly elliptic, smooth, 20 × 10μ; paraphyses filiform, subclavate at the apices.

Peziza setosa—Nees, "Sys.," p. 260, f. 275; Fries,

"Sys. Myco.," ii. p. 87; Weinm., p. 439 (?); Crouan, "Flo. Fin.," p. 52; Cooke, "Grevillea," iii. fig. 220; "Mycogr.," fig. 133. *Humaria setosa*—Fckl., "Symb. Myco.," p. 321.

Exs.—Phil., "Elv. Brit.," No. 161.

On rotten trunks. Autumn.

Cups 2½ lines broad; marginal hairs 400 to 500μ long, attenuated upwards, septate, brown. [It should stand next to *L. scutellata*, on page 222.]

Name—*Seta*, a bristle or hair.

Downton, Salop!

Lachnella flammea. (A. and S.)

Sessile, at first closed, subglobose, then expanded, cupulate, hemispherical, bright red; hymenium the same colour; flesh firm, black; asci cylindraceo-clavate; sporidia 8, oblong, rounded at the ends, straight or slightly bent, becoming pseudo-uniseptate, 10—15 × 3μ; paraphyses filiform.

Peziza flammea—A. and S. in "Consp.," p. 319, t. 11, f. 7; D. C., "Flo. Fr.," p. 24; Pers., "Myco. Eur.," p. 252; Fries, "Sys. Myco.," ii. p. 96; Karst., "Pez. et Ascob.," p. 19; "Mon. Pez.," p. 186; "Myco. Fenn.," p. 151; Nyl., "Pez. Fenn.," p. 28.

Exs.—Rabh., "Herb. Myco.," ed. ii. No. 22; Karst., "Fung. Fenn.," No. 37; Phil., "Elv. Brit.," No. 72; Rehm, "Asco.," No. 418.

On decorticated branches of *Salix aurita.*

Cups about ½ a line broad; consistence dry and firm; hairs red and granular. [Its place is next to *L. papillaris*, p. 257.]

Name—*Flammea*, a flame; from the colour.

Aviemore, N.B.! (Rev. Dr. Keith).

Calloria retrusa. (Phil. and Plow.)

Minute, scattered, at first concealed by the epidermis, then erumpent, sessile, hemispherical or oblong, straw-coloured, smooth; asci clavate; sporidia 8, biseriate, oblong-elliptic, 17—19 × 5μ; paraphyses not seen.

Peziza (Mollisia) retrusa—Phil. and Plow. in "Grevillea," iv. p. 122, t. 62, f. 6.

Exs.—Phil., "Elv. Brit.," No. 126.

On larch-leaves. May.

When dry this is found with difficulty, being contracted and concealed under a kind of lid formed of the ruptured epidermis, but when moist it is sufficiently conspicuous under a pocket-lens.

Name—*Retrusus*, hidden.

Trefriw, North Wales!

Position doubtful.

Peziza Browniana. Blox.

Cups hemispherical, sessile, horny; margin paler. ciliate; disc pallid; sporidia shortly fusiform, hyaline.

Peziza Browniana—Blox. in B. and Br.'s Notices, "Ann. Nat. Hist.," No. 1072; Cooke's "Handbk.," No. 2102.

On dead stems of *Epilobium hirsutum*. Twycross.

Allied to *P. lacustris*. The sporidia are (·00045 in.) ·011 mm. long. The colour is paler; and, when perfect, the ciliated margin, which consists of delicate, flexuous, more or less interwoven hairs, is characteristic (M. J. Berkeley).

The presence of delicate, flexuous hairs on the margin appears to ally this to *Lachnella*, but it is said to be allied to *Peziza lacustris*, Fries, which has no hairs.

Rejected species.

Peziza (Tapesia) Bloxami—B. and Br., "Ann. Nat. Hist.," No. 566; Cooke, "Handbk.," No. 2071.

No asci can be found in this, nor in a specimen found by me in North Wales.

Peziza (Dasyscypha) friabilis—Phil. and Plow. in "Grevillea," iv. p. 121.

This turns out to be a very abnormal form of a *Schmitzomia*, which quite misled me.

Peziza hispidula, Schrad.—Cooke, "Handbk.," No. 2044.

So far as British specimens under this name that I have seen are concerned, they prove to belong to the genus *Excipula*, Fries.

Peziza Scirpi—Rabh., "Herb. Myco.," No. 730; Phil., "Elv. Brit.," No. 183; Cooke, "Fung. Brit.," No. 375.

[This should have been given as a synonym under *Belonidium lacustre* (Fries), p. 149.]

GLOSSARY OF TERMS.

Abbreviated, suddenly shortened.
Acerose, linear and sharp-pointed, like a needle.
Acicular, needle-shaped.
Acuminate, coming gradually to a point.
Adherent, sticking together.
Adnate, attached, adhering by growth.
Adpressed, pressed together.
Æruginous, verdigris-green colour.
Agglutinate, glued together.
Aggregate, crowded together.
Alutaceous, tan-colour or buff.
Amethyst, bluish-violet colour.
Anastomosing, uniting in a network.
Annulate, ringed.
Apiculate, terminating in a sharp but short point.
Apothecium, the organ of fructification which bears the asci, or hymenium, otherwise called the cup or the receptacle.
Applanate, flattened out or horizontally expanded.
Areolæ, spaces distinctly marked out on a surface; small cells or cavities.
Areolate, covered with areolæ.
Argillaceous, clay-colour, light brownish ash-colour.
Articulate, jointed.
Ascending, attaining a vertical position.
Asci, cells containing the sporidia; otherwise called *thecæ*.
Ascigerous, furnished with asci.
Ascus, singular of *Asci*.
Attenuated, tapered, gradually diminished in size.
Aurantiacus, pale orange-colour.

Bay, reddish-brown, inclining to chestnut-colour.
Bi- (from the Latin *bis*, twice), a prefix denoting twice or double; as *bi*seriate, in a double series.
Biguttulate, furnished with two guttulæ or drops.

Bistre, or *Bister*, blackish-brown.
Bullate, blistered, rising into convex prominences.
Byssoid, like fine flax, or cotton wool; of a finely filamentous structure.

Cæspitose, growing in tufts, crowded into turf-like patches.
Campanulate, bell-shaped.
Capitulum, a little head.
Carbonaceous, black like charcoal, hard and black as if charred.
Caulicolæ, growing on herbaceous stems.
Cellular-tissue, tissue composed of cells.
Cellulose, furnished with little cells; in its more restricted meaning it indicates the substance of which the cell-wall is composed.
Celluloso-plicate, folded so as to form small cells.
Cilia, plural of *cilium*, an eyelash.
Ciliated, furnished with cilia, fringed with hairs.
Cinereous, or *Cinereus*, ash-colour, intermediate tint between black and white.
Cinnabarine, scarlet tinged with yellow, vermilion.
Cinnamomeus, of a bright brown colour.
Cinnamon, a bright brown, the colour of cinnamon bark.
Circinate, rolled inwards from the summit towards the base like a crozier.
Citron-colour, pure yellow, lemon-coloured.
Clavate, club-shaped.
Clove-brown, dark brown, the colour of cloves—the dried flower-buds of *Caryophyllus*.
Cochleate, shaped like a snail-shell.
Collapsing, falling together, as of the sides of a hollow vessel.
Compressed, pressed or squeezed together.
Concatenate, linked together, united in a continuous series.
Concentrate, to bring to a common centre.
Concentric, having a common centre.
Concolorous, of one colour, similar in colour.
Concrete, growing together, several parts united so as to form a solid body.
Confluent, merging into each other, flowing together.
Congregate, collected together in close proximity.
Conical, cone-shaped; in the form of a solid figure having a circular base, and its top terminating in a point.
Conidia, minute cells produced by abstriction at the ends of filamentous cells.
Conidiiferous, bearing conidia.
Connate, growing together, growing from one base.
Connivent, arching over to meet.
Constricted, drawn together, bound, contracted.
Contiguous, one part touching another.
Continuous, one part passing into another without any break, sometimes indicating an elongated cell without any septum.

Contorted, twisted together, twisted out of its ordinary form.
Convex, rounded on the outer surface.
Coriaceous, of a leathery consistence.
Corky, of a corky consistence.
Corrugated, wrinkled.
Cortex, rind or bark.
Costate, ribbed.
Crenate, notched, any edge cut into rounded divisions.
Crenulate, notched, indented on the edge.
Cribrose, resembling a sieve or riddle, pierced with numerous holes, pitted.
Crisped, curled, uneven with waving lines.
Crowded, pressed together.
Cruciate, having the form of a cross.
Cruciform, same as *Cruciate*.
Cup, the receptacle of fructification in the *Discomycetes*; by some called the *Apothecium*.
Cupulate, cup-shaped, formed like a little cup, slightly concave.
Cupuliform. See *Cupulate*.
Cyathiform, cup-shaped, but more deeply concave than *Cupulate* implies.
Cylindraceo-clavate, intermediate in shape between cylindrical and clavate.
Cylindrical, long, circular, and of equal diameter throughout.
Cymbiform, boat-shaped.
Cyst, a cell or cavity.

Deciduous, falling off.
Decurrent, running down.
Deflexed, bending downwards, bending outwards and downwards; the opposite of *Inflexed*.
Deformed, disfigured, distorted.
Dehiscing (*dehisco*, to gape), bursting open, splitting.
Dentate, toothed.
Denticulate, furnished with small teeth.
Depressed, pressed down or flattened; sometimes it means somewhat sunk into a concave form.
Diaphanous, transparent, pellucid.
Difformed, irregular in form, not uniform.
Dilated, expanded and flattened out.
Diluted, washy, pale, faint-coloured.
Dimidiate, semi-orbicular.
Disc, or *Disk*, the upper surface of a cup-shaped or plate-shaped receptacle bearing the fructification; generally synonymous with *Hymenium*.
Disciform, shaped like a *discus*, or quoit. See *Discoid*.
Discoid, round and flat like a coin.
Discoloured, appearing to have lost its colour, stained.

Distinct, well marked, not to be confounded with another.
Down, fine soft pubescence on the surface of anything.

Echinulate, beset with short spines.
Effused, spread out over the matrix, spread into a thin layer.
Eguttulate, without drops.
Ejected, thrown out, thrust out with force.
Ellipsoid. See *Elliptic*.
Elliptic, having the form of an ellipse, an oval rounded at the ends.
Elongated, lengthened out.
Endochrome, protoplasm of cells, cell-contents.
Entire, not divided into parts, continuous.
Epiphyllous, growing on a leaf.
Epiphytal, living upon other plants.
Epispore, the outer cell-wall of a spore.
Equal, of the same dimensions, not lop-sided.
Erose, gnawed, as if bitten irregularly.
Erumpent, bursting through the surface of the matrix in which it was embedded.
Evanescent, soon vanishing.
Excavated, hollowed out into a cavity.
Excipulum, external layer of a cup, or a perithecium, sometimes used as a synonym for *Receptacle*, which see.
Expanded, spread out, becoming less concave, as when a cup which is at first nearly closed, assumes a saucer-form.
Exserted, thrust out, protruding beyond the surface.

Farinaceous, mealy, covered with particles resembling meal.
Farinose. See *Farinaceous*.
Fascicle, a little bundle.
Fasciculate, where several similar parts originate at the same spot, and so form a bundle.
Fastigiate, when all the parts are nearly parallel, each pointing upwards.
Fawn-colour, the colour of a young deer.
Fenestrate, divided into compartments like a window.
Ferruginous, the colour of rusty iron, reddish-brown.
Fibril, a fine fibre or filament, hair-like appendage.
Fibrillose, furnished with fibrils, clothed with little loose fibres.
Filiform, thread-shape, cylindrical and slender like a thread.
Fimbriate, fringed.
Fistulose, hollow like a pipe.
Flattened, pressed down, as when a sphere is depressed, or a cylindrical body has its opposite sides brought closer together.
Fleshy, of the consistence of flesh.
Flexuose, bending gently to and fro in opposite directions.
Flocci, fine threads like wool.
Floccose, furnished with a wool-like covering, resembling a flock of wool.

Flocculose, minutely woolly. See *Floccose.*
Forked, separating into two distinct branches which are more or less apart.
Fragile, easily broken, frail.
Friable, easily crumbled, easily reduced to powder.
Fugaceous, flying or fleeting away, soon falling away.
Fuliginous, sooty-brown, brown verging on black.
Fulvous, tawny, the colour of a lion.
Furfuraceous, coated with bran-like particles.
Fuscescent, tending to become fuscous or brown.
Fuscous, or *Fuscus*, brown with a grey tinge.
Fusiform, spindle-shape.
Fuso-filiform, between fusiform and thread-shaped, very slenderly fusiform.
Fusoid, spindle-shaped.

Gelatine, the jelly-like fluid secreted by many fungi.
Gelatinous, having the consistence of jelly.
Glabrous, a surface wholly destitute of pubescence.
Glaucous, sea-green, dull green with a whitish-blue lustre.
Globose, nearly spherical.
Globulose, same as globose.
Granulate, *Granulose*, covered with small grain-like tubercles, made up of, or filled with, minute grains.
Gregarious, growing in company like a flock of sheep, not solitary.
Grumous, clotted, in clustered grains.
Guttate, *Guttulate*, furnished with one or more spherical drops; synonym for *nucleate*. As *nucleus* has now a special meaning, it has been considered better in this work to adopt the word *gutta*, *guttæ*, and *guttulate*, instead of *nucleus*, *nuclei*, and *nucleate* in describing sporidia.
Gyrose, folded and waved, or marked with wavy lines.

Hemispherical, resembling half a sphere or globe.
Hirsute, hairy.
Hispid, furnished with rigid hairs.
Horny, of the consistence of horn.
Hyaline, more or less transparent like glass.
Hymenium, the layer composed of the asci and paraphyses, the disc.
Hypha, pl. *Hyphæ*, the mycelial thread or threads from which the fungus arises.
Hypocrateriform, formed like a goblet, the shape of a cylindrical cup the margin of which turns outward.
Hypophyllous, seated on the under side of a leaf.
Hypothecium, the cellular tissue immediately beneath the hymenium, often called the subhymenial tissue.
Hysteriæform, resembling an *Hysterium*, in the form of a long narrow ridge opening by a longitudinal slit at the top.

Immarginate, without a distinct margin.
Immersed, originating beneath the surface of the matrix, or beneath the soil.
Incised, cut.
Incrassated, thickened.
Indeterminate, undefined, without any distinct boundary.
Inflated, swollen like a bladder, puffed out.
Inflexed, curved or bent inwards.
Infundibuliform, funnel-shaped, a tube below and gradually enlarging upwards.
Innate, born within, originating within the matrix or within the substance of the plant.
Innato-sessile, the base of the receptacle beneath the surface of the matrix, without a stem and somewhat immersed.
Involute, rolled inwards; applied to the margin of the cup when it is rolled inwards.
Irregular, not in a uniform line or circle, unsymmetrical.

Lacerated, torn.
Laciniate, fringed.
Lacunose, having little cavities, pitted.
Lanceolate, shaped like the head of a spear, narrow and tapering at each end.
Lateritious, of a brick-red colour.
Lentiform, lens-shaped.
Linear, in a line, where the sides of a spore or other cell are parallel, and the length considerably longer than the breadth.
Livid, pale bluish or leaden grey.
Lobate, *Lobed*, divided into lobes.
Lurid, of a dingy brown.
Lutescent, yellowish, pale yellow.
Luteus, yellow, like the flowers of woad (*Isatis tinctoria*).

Marginate, having a distinct margin.
Matrix, anything on which a fungus grows.
Mealy, covered with a scurfy powder.
Membranaceous, thin, and more or less transparent.
Mitrate, bonnet-shaped, a rounded and folded pileus.
Moniliform, necklace-like.
Mucous, slimy, of the consistence of gum.
Multi-, a prefix indicating many; as *multi*guttulate, having many guttulæ.
Muricate, rough with short points.
Muriform, where the contents of a sporidium are arranged or divided like the masonry of a stone wall.
Mycelioid, in the form of mycelium.
Mycelium, the hyphæ or filaments produced from fungus spores.

Navicular, boat-shaped; a synonym of *Cymbiform*.
Nigrescent, approaching a black colour.
Nigricant, black.
Nigro-punctate, marked with black points or dots.
Nucleate, having nuclei.
Nucleus, a homogeneous, roundish protoplasm-mass produced by the differentiation of the protoplasm of the cell.* See *Guttulate*.

Obconic, conical, but having the apex downwards.
Oblique, deviating from a right line, aslant.
Oblong, a rectangle, which is longer than it is broad, but used here of sporidia which somewhat approach this form while rounded at the ends.
Obtuse, blunt.
Ochery, the colour of ochre; synonym for *Ochraceous*.
Ochraceous, *Ochraceus*. See *Ochery*.
Olivaceous, of an olive-green colour, orange and grey.
Olive. See *Olivaceous*.
Opaque, not transparent, not shining.
Operculum, a cover or lid; applied to the membrane which is raised for the exit of the sporidia. Seen best in *Ascobolus*.
Orange, the colour of an orange; synonym of *Aurantius*.
Orbicular, of a round form, circular.
Ovate, shaped like an egg, somewhat broader at the base than the summit.
Ovoid, synonym for *Ovate*.

Pallid, pale, but undecided in colour.
Papilla, a nipple-like protuberance, often consisting of a single cell.
Papillate, covered with papillæ, or ending in a papilla.
Paraphyses, minute hyaline filaments surrounding the asci.
Parenchyma, the cellular tissue forming the interior of the receptacle. See *Pseudo-parenchyma*.
Patellate, *Patelliform*, shaped like a dish.
Pellucid, transparent, not opaque.
Peltate, formed like a pelta or shield, a shield supported in the middle on the point of a projecting body.
Perithecium, a closed receptacle containing the hymenium, as in the genus *Sphæria*, being at length perforated by a pore at the summit.
Persistent, enduring, remaining beyond the period of maturity, not soon decaying.
Pileate, furnished with a cap, having a more or less enlarged head.
Pilose, hairy.
Placentiform, a thickened circular disc, depressed in the middle both above and below.

* Sach's "Text-Book of Bot.," 2nd ed. pp. 2, 38, 44.

Plane, flat, a level surface
Plano, used in combination ; as *plano*-convex, between plane and convex.
Plicate, folded in longitudinal plaits.
Poculiform, cup-shaped.
Polari-nucleate, having nuclei at the ends of a sporidium.
Pole, the end of a sporidium.
Polygonal, having many angles.
Polymorphous, having many forms, where any plant or part of a plant has a diversity of forms.
Polysporus, having many spores.
Pore, a minute superficial hole.
Process, an extension or projection from a surface.
Produced, where a part is brought forward or lengthened out in any direction.
Protoplasm, the living contents of a cell, consisting of a combination of albuminous substances with water and small quantities of incombustible materials (ash).*
Pruinose, frosted or covered with bloom like a plum.
Pseudo-parenchyma, false parenchyma, the cellular tissue of fungi, which, although resembling true parenchyma, is not so.
Pseudo-septate, having the appearance of being septate.
Pubescent, coated with elevated extensions of the cellular tissue of the epidermis, assuming the character of minute hairs or down.
Pulverulent, dusted over, powdery.
Pulvinate, cushion-shaped, a little prominence like a cushion.
Pycnidia, receptacles enclosing stylospores.
Pyriform, pear-shaped.

Quadrate, square in form.

Receptacle, the portion of a fungus bearing the hymenium, the apothecium, the cup.
Reniform, kidney-shaped, resembling the section taken longitudinally through a kidney.
Repand, bowed, having an uneven, slightly sinuous margin.
Replicate, doubled down, so that the upper part comes in contact with the lower; folded back, as when the margin of a cup turns outwards and downwards.
Reticulated, forming a network, having veins or lines crossing like network..
Revolute, rolled backwards, as when the margin of a cup is rolled outwards.
Rigid, stiff, with slight or no flexibility.
Rimose, where a surface is covered with cracks or fissures.
Rivulose, marked with lines like the rivers in a map.
Rooting, emitting roots, extending the stem downwards into the earth or matrix in the form of a root.

* Sach's "Text-Book," 2nd ed. p. 37.

Rotundate, round, orbicular.
Rufescent, reddish brown.
Rufous, *Rufus*, full red-brown.
Ruga, a wrinkle.
Rugose, *Rugulose*, wrinkled on the surface.

Scabrous, rough, covered with minute elevations.
Scarce, rarely present, occurring here and there.
Scattered, not crowded, being at some distance apart.
Saccharine, resembling sugar, covered with shining grains like sugar.
Sclerotium, an old genus of fungi comprising hard, black, compact bodies which are now proved to be a resting condition of the mycelium of certain fungi, as of *Peziza tuberosa*, etc.
Scrobiculate, marked with little pits.
Scutellate, formed like a dish or saucer, orbicular and nearly flat.
Septate, having divisions, partitioned off into separate compartments.
Septum, the division wall of a cell.
Seriate, arranged in a row.
Serrated, toothed on the margin like the edge of a saw.
Setaceous, furnished with bristles, in the form of a bristle.
Setulose. See *Setaceous*.
Sinuate, *Sinuous*, *Sinuose*, the margin uneven with alternate concavities and convexities.
Solitary, not closely associated with others.
Spadicious, date-brown, duller and darker than bay-brown.
Spathulate, spoon-shaped, rounded at the summit and narrowed towards the base.
Spermogonia, receptacles in which spermatia are produced in fungi and lichens.
Spherical, *Spheroid*, shaped like a sphere.
Spicula, a little spike.
Sporidiiferous, bearing sporidia.
Sporidium, an ascospore, or endospore; differs from a spore in being developed within another cell.
Spurious, false, counterfeit, having only an appearance.
Squamulose, covered with small scales.
Stellate, star-shaped, radiating from a common centre.
Sterigmata, a prop, a filament which supports a spore.
Stipitate, having a stem.
Stuffed, filled with a cottony web or spongy mass distinct from the walls.
Striate, channelled, furrowed, marked with grooves.
Strigose, rough with fascicles of hairs, hispid.
Stroma, a more or less continuous layer, varying in consistence from fleshy to carbonaceous, arising from the mycelium, on which the receptacles are seated, as in the genera *Ephelis* and *Dermatea*.
Stylogonidia, gonidia formed by abstriction on the ends of special filaments.

Stylospores, stalked spores, either produced within a special receptacle, as in *pycnidia*, or unenclosed, as amongst the *Coniomycetes*.
Sub-, a prefix to another word, implying somewhat near the thing named; as *sub*globose, somewhat globose.
Subhymenial, immediately beneath the hymenium.
Subiculum, a mass of filaments, a layer of loosely compacted mycelium on or amongst which the receptacles are developed.
Subterranean, growing beneath the surface of the ground.
Subulate, awl-shaped, like a cobbler's awl.
Succulent, juicy, when the cellular tissue is abundant and replete with juices.
Sulcate, furrowed, marked by depressed parallel lines.
Sulphureous, the colour of sulphur, a pale tint of pure yellow.
Superficial, seated on the surface.
Superior, higher up, situated above another, on the top.

Tan-coloured, the colour of wash-leather; synonym of *alutaceous*.
Tapesium, a carpet or layer of mycelium on which the receptacle is seated.
Tawny, a yellowish dark colour, a deeper shade than tan-colour.
Terete, cylindrical and tapering.
Testaceous, brick-coloured, a reddish-brown, not so bright as *lateritious*.
Thalamium, synonym for *Hymenium*.
Thickened, when the thickness of a part is relatively greater than the adjoining part; synonym for *Incrassated*.
Tomentose, covered with pubescence consisting of hair closely matted, coated with down-like hairs.
Tomentum, flocks of wool, loosely matted fibres.
Translucent, transparent, admitting rays of light, clear.
Tremellose, shaking like jelly, of a jelly-like consistence.
Tri-, a prefix denoting three; as *tri*septate, having three septa.
Truncate, terminating as if abruptly cut off.
Tuberculate, covered with pimples or tubercles, having tuberous swellings.
Tuberous, in the form of a tuber.
Tumid, swollen, inflated.
Turbinate, top-shaped, having an outline similar to a boy's spinning-top.

Umber, a dark brown, the colour of umber.
Umbilicate, having a little navel, having a little depression in the centre.
Uncinate, hooked or hook-shaped.
Undulated, waved, with gentle elevations and depressions; synonym for *Repand*.
Uni-, a prefix denoting one or the same: as *uni*septate, having one septum; *uni*form, of one form.
Unilocular, having but one cell.

Uniseriate, in one series.
Urceolate, shaped like a pitcher with a contracted mouth.
Urn-shaped, shaped like a vase roundish in form and enlarged in the middle.

Vasculiform, having the form of a little vessel, like a common flower-pot.
Veil, a partial covering of the cup; a membranaceous, fibrous, or granulose coating stretching over the mouth of the cup, soon breaking up into fragments.
Venoso-costate, having raised lines partly resembling veins and partly ribs.
Ventricose, big-bellied, swollen out, puffed up.
Verrucose, warted.
Vesicular, like a bladder.
Villose, *Villous*, covered with long, weak hairs.
Vinous, the colour of red wine.
Vitelline, the colour of the yolk of an egg.

Waved, having an alternately concave and convex surface or margin.
Waxy, the consistence of wax.

AUTHORS QUOTED.

(*See Exsiccati*, p. 436.)

A. and S.

Conspectus Fungorum in Lusatiæ Superioris Agro Niskiensi crescentium. Par J. B. de Albertini et L. D. de Schweiniz. 8vo. Lipsiæ: 1805. 12 pl. col.

Afzel. in Vet. Ac. Handl.

De Vegetabilius Suecanis Observationis et Experimenta. Adamus Afzelius. Upsaliæ: 1785.

Ann. Nat. Hist.

Annals and Magazine of Natural History. London: 1838–1885. Berkeley and Broome's contributions are quoted by the number attached to the species.

Ann. Sc. Nat.

Annales des Sciences Naturelles, Botanique. 6 series. Paris: 1824–1885.

Auers. in Hedwig.

B. Auerswald's contributions to Hedwigia.

Badham.

Esculent Funguses. Dr. Badham. 8vo. London: 1847.

Bail.

Das System der Pilza. By Theodor Bail. Bonn: 1856.

Balb. in Memoir Acad. Imp. Tur.

G. B. Balbis in Memoire della Imp. Accademia delle Scienze di Torino. Turin.

——, *Act. Taur.* Same as preceding.

B. and Br.

Rev. M. J. Berkeley and C. E. Broome. See *Ann. Nat. Hist.*

Barla.
Les Champignons de la Province de Nice. J. B. Barla. Folio-ob. Nice: 1859.

Batsch.
Elenchus Fungorum. Augustus Batsch. Halæ: 1783–1786.

——, *Cont.*
Continuation of above in vol. ii.

Batt.
Fungorum Agri Arminensis Historiæ. A. J. Antonio Battarra. 4to. Faventiæ: 1755.

Berk. and Curt.
Rev. M. J. Berkeley and Dr. Curtis, Notices of North American Fungi, in Grevillea.

Berk.
Rev. M. J. Berkeley.

——, *Crypt. Bot.*
Introduction to Cryptogamic Botany. 8vo. London: 1857.

——, *Outl.*
Outlines of British Fungology. 8vo. London: 1860.

——, *Proc. N. H. Soc. Berw.*
Proceedings of the Natural History Society of Berwick-on-Tweed.

Berl. Ges. Naturf.
Berliner Gesellschaft Naturforschender Freunde. Berlin: 1775–1880.

Bernh. Manip.
An old author quoted by Fries in Systema Mycologicum.

Bert. in Mont. Syll.
M. Bertero in Montagne's Sylloge.

Bisch., Krypt.
Kryptogamen-Kunde. Theophilus Bischoff. 4to. Nürnberg: 1860.

Bivona Manip.
Stirpium rariorum minusque cognitarum in Sicilia sponte provenientium descripto. A. B. Bivona. Manipulus iv. Panormi: 1813.

Bolt.
A History of Funguses growing about Halifax. James Bolton. 4to. Huddersfield: 1788–1791.

Bon., Handb.
Handbuch der Allgeminen Mykologie. H. F. Bonorden. 8vo. Stuttgart: 1885.

Bot. Central.
Botanisches Centralblatt. 8vo. Kassel: 1880.

Bot. Zeit.
Botanische Zeitung. Berlin and Leipzig: 1843–1886.

Boud., Ascob.
Memoire sur les Ascobolés. E. Boudier in Ann. Sc. Nat., 5th ser. vol. x., and published separately. Roy. 8vo. Paris: 1869.

——, *Soc. Bot. de Fr.*
Bulletin de la Société Botanique de France. 8vo. Paris: 1854–1886.

Brefeld, Schim.
Botanische Untersuchungen über die Schimmelpilze. O. Brefeld. 5 hefte. 4to. Leipzig: 1872–1883.

Bucknall.
Fungi of the Bristol District, in Proceedings of the Bristol Naturalists' Society. Bristol: 1878–1886.

Bull.
Histoire des Champignons de la France. Pierre Bulliard. Folio. 16 vols. Paris: 1791–1798.

Bull. Acad. Belg.
Bulletin de l'Académie Royale de Belgique. 8vo. Bruxelles.

Bullet. Buff.
Bulletin of the Buffalo Society of Natural Sciences. 8vo. Buffalo: 1873–1886.

Bull. Soc. Belg.
Bulletins de la Société Royale de Botanique de Belgique. 8vo. Bruxelles.

Bull. Torr. Club.
Bulletin of the Torrey Botanical Club. 8vo. New York.

Buxb., Petr.
Joannes Buxbaum. Commentarii Academiæ Imperialis Scientiarum Petropolitanæ.

Carus, Nov. Act. N. C.
F. W. Carus in Nova Acta Naturæ Curiosorum, xvii. pp. 370–375, t. 27; t. 10–31. 4to. Vratislaviæ, Bonnæ, Jenæ, and Dresdæ: 1820–1864.

Cheval., Flo. En. Par.
Flora Générale des Environs de Paris. François Chevallier. 1 vol. Folio. Paris: 1826–1836.

Cœmans, Not. Ascob. Belg.
Notice sur les Ascobolus de Belgique. Eugène Cœmans. 8vo. Bruxelles: 1862.

——, *Com. Soc. Critt. Ital.*
Commentario della Societa Crittogamologica Italiana. Genova: 1860.

Cooke, Handbk.
Handbook of British Fungi. M. C. Cooke, M.A. 2 vols. 8vo. London: 1871.

Cooke, Mycogr.
Mycographia seu Icones Fungorum, Discomycetes. By the same author. 1 vol. Roy. 8vo. London: 1879.
——, Fungi: Their Nature, Influence, and Uses. 8vo. London: 1875.

Corda, Anl.
Anleitung zum Studium der Mycologie. 8vo. Prag: 1842.
——, *Icon.*
Icones Fungorum Hucusque Cognitorum. August Corda. 6 fasc. Folio. Pragæ: 1838–1856.

Crouan, Flo. Fin.
Florule du Finisterre. P. L. et H. M. Crouan. 1 vol. Roy. 8vo. Brest: 1867.

Cum., Act. Tur.
A. Cumino in Act. Ac. Taurini. 1806.

D. C., Flo. Fr.
Flore Française. A. P. de Candolle et Lamarck. 5 vols. 8vo. Paris: 1805, etc.

De Not., Disc.
Proposte di Alcune Rettificazioni al Profilo dei Discomiceti. G. de Notaris. 34 pp. Genova: 1864.
——, *Micro. Ital.*
Mycromycetes Italici novi vel minus cogniti. Decades i.–ix. Turin: 1839–1856.

Dicks., Crypt.
Plantarum Cryptogamicarum Britanniæ. Jacobi Dickson. 4 fasc. 4to. Londini: 1785–1801.

Dill., Gen.
Nova Plantarum Genera in Catalogus Plantarum sponte circa Giessam nascentium. Joannes Dillenius. Francofurte ad Mœnum: 1719.

Ditm. in Sturm, Deut. Flo.
N. Ditmar, Die Pilze Deutschlands, in Sturm's Deutschlands Flora. Nürnberg: 1813–1817.

Doass., Revue Myco.
MM. Doassans et N. Patouillard in Revue Mycologique. Toulouse and Paris: 1879–1886.

Dr. and M., Flo. d'Algérie.
MM. Durieu et Montagne in Exploration Scientifique de l'Algérie. Bory de St. Vincent and Durieu de Maisonneuve. 4to. Paris: 1846–1849.

Dr. and Lev.
MM. Durieu de Maisonneuve and Leviellc in preceding work.

Duby, Bot. Gall.
Botanicon Gallicum. Joannes Stephanus Duby. Paris: 1882–1830.

Eng. Flo.
English Flora. Sir J. E. Smith. Vol. v. part 2. By Rev. M. J. Berkeley. 8vo. London: 1837.

Farlow, Pro. Ann. Ac. A. and S.
Professor W. G. Farlow in Proceedings of the American Academy of Arts and Sciences. 1883.

Favre-Guill.
Les Champignons Comestibles du Canton de Neuchâtel. L. Favre-Guillarmond. 4to. Neuchâtel: 1861.

Fckl., Bot. Zeit.
Fuckel's contributions to Botanisches Zeitung.

——, *Symb. Myco.*
Symbolæ Mycologicæ. Beitrage zur Kenntniss der Rhainischen Pilze. L. Fuckel. 8vo. Wiesbaden: 1869–1875.

Flo. Boruss.
Flora Borussica. J. C. Wulff. Regiomonti: 1765.

Flo. Chil.
Flora Chilena. MM. Decaisne et Nauden. 4 vols. 8vo. Paris: 1845–1849.

Flo. Dan.
Floræ Danicæ. Icones Plantarum sponte nascentium in regnis Daniæ et Norvegiæ. Folio. 1766–1882.

Flo. Tasm.
Flora Tasmaniæ. J. D. Hooker. 2 vols. 4to. London: 1860.

Fresen., Beit.
Beiträge zur Mykologie. G. Fresenius. 3 hefta. 4to. Frankfort: 1850–1863.

Fries, Elench.
Elenchus Fungorum sistens Commentarium in Systema Mycologium. Vol. ii. 8vo. Gryphiswaldiæ: 1828.

——, *Epic.*
Epicrisis Systematis Mycologici seu Synopsis Hymenomycetum. Elias M. Fries. Upsaliæ: 1836–1838.

——, *Icon. Select.*
Icones Selectæ Hymenomycetum Nondum Delineatorum. Elia Fries. Folio. Holmiæ: 1867–1884.

——, *Nov. Sym. Myco.*
Novæ Symbolæ Mycologicæ. E. Fries. Upsal: 1851.

——, *Obs. Myco.*
Observationes Mycologicæ, præcipue ad Illustrandam Floram Suecicam. Holmiæ: 1815–1818.

Fries, Summa Veg. Scan.
Summa Vegetabilium Scandinaviæ. Elias M. Fries. 2 vols. 8vo. Upsaliæ: 1846.

——, *Sys. Myco.*
Systema Mycologicum, sistens Fungorum Ordines, Genera et Species hucusque cognitas. Elias M. Fri s. 3 vols. 8vo. Gryphiswaldiæ: 1821–1830.

Gard. Chron.
Gardener's Chronicle. Folio. London: 1841–1886.

Gerard in Bull. Torr. Club.
W. R. Gerard's contributions to Bulletin of the Torrey Botanical Club. New York.

Gonn. and Rabh.
Mycologia Europæa. Gonnermann und Rabenhorst. Heft. i.–ix. Folio. Dresden: 1870.

Grev., Flo. Edin.
Flora Edinensis. R. K. Greville. 8vo. Edinburgh: 1824.

——, *Sc. Crypt. Flo.*
Scottish Cryptogamic Flora. R. K. Greville. 6 vols. 8vo. Edinburgh: 1823–1828.

Grevillea.
Grevillea: a Quarterly Record of Cryptogamic Botany. 8vo. London: 1872–1886.

Gill., Champ.
Champignons de France, Les Discomycetes. Par C. C. Gillet. Alençon: 1879.

Hartig, Krank. Waldb.
Wichtige Krankheiten der Waldbäume. R. Hartig. Berlin: 1874.

Harzer.
Naturgetreue Abbildungen der vorzüglichsten Essbaren, Giftigen und Verdachtigen Schwamme. Karl A. F. Harzer. Dresden: 1842.

Hayd., Geol. Rept.
F. V. Hayden's Annual Reports of the United States Geological Survey of the Territories. 1869–1879.

Hedw., Mus. Frond.
Species Muscorum Frondosorum. Joanne Hedwig. 4 vols. Folio. 1787–1797. Fungi in vol. ii.

Hedwig. or Hedw.
Hedwigia. Notizblatt für Kryptogamiche Studien. 8vo. Dresden.

Herb. Berk.
Herbarium of the Rev. M. J. Berkeley in the National Herbarium, Royal Gardens, Kew.

Hoff., Icon. An.
Icones Analyticæ Fungorum. Herman Hoffman. Giessen: 1836.

Hoffm., Crypt.
Vegatabilia Cryptogama. Georgius Hoffmann. Erlangæ: 1787–1790.

Holms., Ot.
Beata Ruris Otia Fungis Danicis Impensa. Theodorus Holmskiold. Havniæ: 1818.

Hook., Jour.
Journal of Botany. W. J. Hooker. 8vo. London: 1834–1857.

Huds., Flo. Ang.
Flora Anglica. Gulielmi Hudsoni. 2 vols. 8vo. London: 1778.

Humb., Flo. Frib.
Floræ Fribergensis Specimen Plantas Cryptogam. Alexander von Humboldt. Berolini: 1793.

Huss.
Illustrations of British Mycology. Mrs. Hussey. 2 series. 4to. London: 1847–1855.

Inzenga, Fungi Sici.
Funghi Siciliani. G. Inzenga. 2 parts. 4to. Palermo: 1869–1879.

Jacq., Misc. Austr.
Miscellanea Austriaca ad Botanicam. Nicolaus Josephus Jacquin. 4to. Viennæ: 1773–1778.

Johnst., Flo. Berw.
Flora of Berwick-upon-Tweed. George Johnston. 2 vols. Edinburgh: 1829.

Jour. Bot.
Journal of Botany, British and Foreign. New series. 22 vols. 8vo. London: 1862–1886.

Jour. Hort.
Journal of the Royal Horticultural Society. London.

Jour. Linn. Soc.
Journal of the Linnæan Society. Botany. 8vo. London.

Kalch., Icon. Select.
Icones Selectæ Hymenomycetum Hungariæ. Caroli Kalchbrenner. 4to. Pestini. 1873–1877.

Karst., Mon. Pez.
Monographia Pezizarum Fennicarum. P. A. Karsten. 1 vol. 8vo. Helsingfors: 1868.

——, *Myco. Fenn.*
Mycologia Fennica. P. A. Karsten. 8vo. Helsingfors: 1871.

——, *Pez. et Ascob.*
Synopsis Pezizarum et Ascobolorum Fenniæ. 1 vol. 8vo. Helsingfors: 1861.

Karst., Symb.
Symbolæ ad Mycologiam Fennicam. Pts. i.–xii. 8vo. 1871–1883.

Kickx, Crypt. Flan:
Flore Cryptogamique des Flandres. J. Kickx. Bruxelles: 1867.

——, *Flo. Flan.*
Recherches pour servir à la Flora Cryptogamique des Flandres Cent. i.–v. Bruxelles: 1841–1855.

Kromb.
Naturgetreue Abbildungen der Essbaren Schadlichen, und Verdachtigen Schwämme. Julius von Krombholz. Folio. Prag: 1831–1849.

Lenz.
Die Nützlichen und Schädlichen Schwämme. F. A. Lenz. Gotha: 1840.

Leveillé.
J. H. Leveillé, various Memoirs in Annales des Sciences Naturelles, etc.

Lightf.
Flora Scotica; or, a System of the Native Plants of Scotland and the Hebrides. John Lightfoot. 2 vols. London: 1777.

Link., Hand.
Handbuch zur Erkenntniss der Nutzbarsten und am haufigsten vorkommenden Gewachse. Henricus Link. Berlin: 1829–1833.

L. or Linn.
Carl von Linnæus.

——, *Suec.*
Flora Suecica. Holmiæ: 1745–1755.

——, *Spec. Plant.*
Species Plantarum. 1753.

——, *Sys. Veg.*
Systema Vegetabilium. Gœttingæ: 1774–1784.

Linn. Jour.
Journal of the Linnæan Society. Botany. 8vo. London: 1857–1886.

Linn. Trans.
Transactions of the Linnæan Society. Botany. 8vo. London: 1791–1886.

Mag. Zool. and Bot.
Magazine of Zoology and Botany. Vol. i. 8vo. 1837.

Mart., Erl.
Flora Cryptogamica Erlangensis. Carolus de Martius. Norimbergæ: 1817.

Mass., *Fram.*
Frammenti Lichenografici. A. Massalongo. 8vo. Verona: 1883.

Mérat, *Flo. En. Par.*
Nouvelle Flore des Environs de Paris. François Victor Mérat. Paris: 1812, 1831, 1837.

Mich., *Gen.*
Nova Plantarum Genera. Petro Antonio Michelio. 4to. Florentiæ: 1729.

Mont., *Syll.*
Sylloge Generum Specierumque Cryptogamarum quas in variis operibus descriptas nunc ad diagnosim reductas nonnullasque novas interjectas ordine systematico disposuit. Jean F. C. Montagne. 8vo. Paris: 1856.

——, *Ann. Sc. Nat*
Contributions to Annales des Sciences Naturelles, Botanique. 1824–1886.

Nees, *Sys.*
Das System der Pilze. C. G. Nees von Essenbeck. 4to. Würzburgh: 1817.

Nees von Esen. u. Hen. Sys. der Pilze.
Das System der Pilze. Dr. Th. F. L. Nees von Esenbeck und A. Henry. 8vo. Bonn: 1837.

Nyl., *Pez. Fenn.*
Observationes circa Pezizas Fenniæ. William Nylander. 1 vol. 8vo. Helsingfors: 1868.

Oest. Bot. Zeit.
Oesterreichische Botanische Zeitschrift. Wein: 1850–1866.

Öfv. Vet. Ak. Handl.
Ofversigt af Kongl-Vetenskaps Akademiens Förhandlingar. Stockholm.

Oudemans in Arch. Need.
C. A. J. Oudemans. Contributions to Archives Néederlandaises. Haarlem: 1866–1886.

Pat.
Tabulæ Analyticæ Fungorum. By N. Patouillard. Fas. i.–v. Poligny: 1883–1886.

Payer.
Botanique Cryptogamique. J. Payer. 4to. Paris: 1850. 2nd ed., Paris: 1881.

Peck, *Report N. Y. St. M.*
Report of the Botanist (Charles H. Peck), made to the Regents of the University of the State of New York. 1873–1886.

Pers.
C. H. Persoon.

——, *Comm.*
Commentatio de Fungis Clavæformibus. C. H. Persoon. Lipsiæ: 1797.

——, *Commest.*
Traité sur les Champignons Comestibles. C. H. Persoon. Paris: 1818.

——, *Icon. et Descr.*
Icones et Descriptiones Fungorum Minus Cognitorum. C. H. Persoon. 4to. Lipsiæ: 1798–1800.

——, *Icon. Pict.*
Icones Pictæ Rariorum Fungorum. C. H. Persoon. 4to. 1803–1806.

——, *Myco. Eur.*
Mycologia Europæa. C. H. Persoon. 3 vols. 8vo. Erlangæ: 1822–1828.

——, *Obs.*
Observationes Mycologicæ. 8vo. Lipsiæ: 1799.

——, *Syn. Fung.*
Synopsis Methodica Fungorum. C. H. Persoon. 1 vol. 12mo Gottingæ: 1801–1808.

——, *Tent. Disp. Meth.*
Tentamen Dispositionis Methodicæ Fungorum. C. H. Persoon. Lipsiæ: 1797.

Phil. and Plow.
New and Rare British Fungi in Grevillea. W. Phillips and C. B. Plowright.

Price.
Illustrations of the Fungi of our Fields and Woods. Sarah Price. 2 vols. 4to. London: 1864–1865.

Pro. Am. Ac. A. and S.
Proceedings of the American Academy of Arts and Sciences.

Purton, Mid. Flo.
Midland Flora: a Botanical Description of British Plants in the Midland Counties. 2 vols. 8vo. Stratford-upon-Avon: 1817.

Quelet, Champ.
Les Champignons du Jura et des Vosges. L. Quelet. 8vo. Montbéliard: 1872–1875.

——, *Assoc. Fr.*
Report of the Association Francais pour L'Avancement des Sciences. 8vo. Paris: 1880–1884.

Rabh., Handb.
Deutschlands Kryptogamen Flora. Oder Handbuch zur Bestim-

mung der kryptogamischen Gewächse Deutschlands, etc. Dr. L. Rabenhorst. 8vo. Leipzig: 1847.

Rabh., Krypt. Flo.
Kryptogamen Flora von Sachsen; der Ober-Lausitz, Thüringen und Nordböhemen. Dr. L. Rabenhorst. Leipzig: 1863.

Rathey, Oest. Bot. Zeit.
Rathey's contributions to Oesterreichische Botanische Zeitschrift.

Rebent., Neom.
Prodromus Floræ Neomarchicæ. Joannes Rebentisch. Berolini: 1804.

Relhan.
Flora Cantabrigiensis. R. Relhan. Ed. iii. Cætabrigiæ. 1820.

Renny, Trans. Woolhope Club.
Contributions to the Transactions of the Woolhope Club. By James Renny. 8vo. Hereford: 1873.

Revue Myco.
Revue Mycologique. 8 vols. 8vo. Toulouse: 1879–1886.

Rob. in Desm., Crypt. Fr.
M. Roberge in Desmazieres' Notices sur les Plantes Cryptogames, in Annales des Sciences Naturelles.

Rost.
Rostrup in Botanisk Tidsskrift. Kjöbenh: 1866–1883.

Roth, Cat.
Catalecta Botanica. A. W. Roth. Leipsiæ: 1797–1806.

Roumg., Crypt. Illus.
Cryptogamie Illustrée. M. Casimir Roumeguére. 4to. Paris: 1870.

Sacc., Fung. Ven.
Fungi Veneti Novi vel Critici. Ser. i., in Nuovo Giorn. Bot. Ital., vol. for 1873; ser. ii., in vol. for 1875; ser. iii., in Hedwigia, xiv., for 1875; ser. iv., Atti della Soc. Veneto-Trientina di Scienze Nat., iv., 1875; ser. v., in Nuovo Giorn. Bot. Ital., viii., 1876; ser. vi.–xi., in Michelia, i.–vi. Padova: 1877–1880. By P. A. Saccardo.

——, *Mich.*
Michelia Commentarium Mycologicum. P. A. Saccardo. 2 vols. 8vo. Patavii: 1877–1882.

——, *Myco. Ven. Sp.*
Mycologiæ Venetæ Specimen. By P. A. Saccardo. 1 vol. 8vo. Patavii: 1873.

Sadebeck., Wint. Krypt. Flo.
R. Sadebeck in Rabenhorst's Kryptogamen Flora von Deutschland Oesterreich und der Schweiz. Pilze. G. Winter. 8vo. Leipzig: 1884.

Sch. Flo. Bar.
Baierische Flora. Franz de Paula von Schrank. Munich: 1718.

Schæff., Icon.
Fungorum qui in Bavaria et Palatinata circa Ratisbonam Nascunter Icones. Jacobi Christiani Schæffer. 2 vols. 4to. Ratisbonæ: 1762.

Schmid., Icon.
Icones Plantarum et Analyses Partium æri incisæ atque vivis Coloribus insignitæ. C. C. Schmidel. Norimbergæ: 1747–1762. Erlangæ: 1793–1797.

Schmidt, Myco. Heft.
Kunze und Schmidt. Mycologische Heft. G. H. S. Kunze and J. K. Schmidt. Leipsig: 1817–1823.

Schrad. in Pers. Comm.
Schrader in Persoon's Commentatio de Fungis Clavæformibus.

Schrad., Bot. Jour.
Henricus Adolphus Schrader's Contributions to the Neues Journal für die Botanik. Erfurt: 1806–1810.

Schum., Saell.
Enumeratio Plantarum in partibus Sællandiæ Septentrionalis et Orientalis Crescentium. C. F. Schumacher. Havniæ: 1801–1803.

Schw., Syn.
Synopsis Fungorum Carolinæ Superioris. L. de Schweiniz. 4to. Leipzig: 1822.

Scott. Nat.
The Scottish Naturalist. 8vo. 1872–1886.

Scop.
Flora Carniolica. J. A. Scopoli. Viennæ: 1760–1772.

Secr., Mycogr.
Mycographie Suisse ou Déscriptions des Champignons qui croîssent en Suisse. Louis Secretan. Genève: 1833.

Smith, Diseases.
Diseases of the Field and Garden Crops. W. G. Smith. London: 1884.

Sommf., Lapp.
Supplementum Floræ Lapponicæ. Christianus Sommerfelt. Christianiæ: 1826.

Sow., Fung.
English Fungi. James Sowerby. 3 vols. Folio. London: 1797–1809.

Steven., Myco. Scot.
Mycologia Scotica. Rev. John Stevenson. 1 vol. 8vo. Edinburgh: 1879.

Sturm., Flo.
Deutschlands Flora. Pilze. Jacob Sturm. 12mo. Nürnberg. 1817–1851.

Sv. Bot.
Svensk Botanik. O. Swartz. Stockholm. 1803–1809.

Swartz, Vet. Ac. Handl.
Olof Swartz, in Swenska Vetenskaps-Akademien (Kongl) Handlingar. 8vo. Stockholm: 1739–1855.

Timm., Megap.
Floræ Megapolitanæ Prodromus. J. C. Timm. Lipsiæ: 1788.

Tode, Fung. Meckl.
Fungi Mecklenburgenses Selecti. Henricus Julius Tode. Lünebergi: 1790–1791.

Trans. Bot. Soc. Edin.
Transactions of the Botanical Society of Edinburgh. 8vo. 1841–1886.

Tratt., Austr.
Fungi Austriaci Iconibus Illustrati. Leopoldus Trattinnick. 4to. Wein: 1805.

——, Die Essbaren Schwämme. Leopoldus Trattinnick. Wien und Triest: 1809. Wein: 1830.

Tul., Select. Fung. Carp.
Selecta Fungorum Carpologia. L. R. et C. Tulasne. 3 vols. Folio. Paris: 1865.

——, *Hyp.*
Fungi Hypogæi. L. R. & C. Tulasne. Folio. Paris: 1862.

Vaill., Bot.
Botanicon Parisiense. Sebastianus Vaillant. Lugduni Batavorum et Amstelodami: 1727.

Vet. Ac. Handl.
Handlinger Konigliche Svenska Vetenskaps Academieus. Stockholm: 1819.

Ventenant.
M. Louis Ventenant in Mémoires du Muséum d'Histoire Naturelle. Paris: 1815–1832.

Vill., Delph.
Flora Delphinalis. By Dominique Villars. 8vo. Grenoble: 1785.

Vitt., Mang.
Descrizione dei Funghi Mangerecci piú Communi del l'Italia. Carolus Vittadini. Milano: 1835.

Weberb.
Die Pilze Nord-Deutschlands. Otto Weberbauer. 2 pts. Folio. Breslau: 1873–1875.

Weinm., Hym.
Hymeno et Gasteromycetes hucusque in Imperio Rossico Observati. J. A. Weinmann. Petropoli, 1836.

Wahl., Flo. Suec.
Flora Succica. Goeran Wahlenberg. Upsaliæ et Lipsiæ: 1824–1826; and Upsaliæ: 1831–1833.

——, *Ups.*
Flora Upsaliensis. Goeran Wahlenberg. 8vo. Upsaliæ et Lipsiæ: 1820.

Wallr., Crypt. Flo.
Flora Cryptogamica Germaniæ. Fred. Guil. Wallrothio. 2 vols. 12mo. Norimbergæ: 1831–1833.

——, *Flo. Germ.*
The same work.

West.
G. D. Westendorp in Bulletin de l'Acad. Roy. de l'Belgique. 1861.

Wigg., Hoffm. Crypt.
See Hoffm. Crypt.

With.
An arrangement of British Plants. William Withering, M.D. 3rd ed. 4 vols. 8vo. London: 1796.

Wright, Cub.
Mr. Charles Wright's specimens of Cuban Fungi described by Messrs. Berkeley and Curtis. Journal of the Linnæan Society, vol. x. p. 280.

EXSICCATI.

Ayres, exs.
Mycologia Britannica; or, Specimens of British Fungi. By Philip B. Ayres, M.D. Fasc. 1, 2. 4to. Pamplin. London: 1845.

B. and Br.
Rev. M. J. Berkeley and C. E. Broome, in the Herbarium, Royal Gardens, Kew.

Baxt., exs.
Stirpes Cryptogamicæ Oxonienses, or Dried Specimens of Cryptogamous Plants, by William Baxter, A.L.S. Oxford: 1825.

Berk., Brit. Fung.
British Fungi. Rev. M. J. Berkeley. 4 fasc. 4to. London.

Blox. in Herb Kew.
Rev. Andrew Bloxam's specimens in the Herbarium, Royal Gardens, Kew.

Cooke, Fung. Brit.
Fungi Britannici Exsiccati. 1st ser., i.–vi. 8vo. London: 1865–1871. 2nd ser., i.–vii. 4to. London: 1875–1879.

Desm., Crypt. Fr.
Plantes Cryptogamiques de France. J. B. Desmazieres. 4to. Lille: 1825–1860.

Ellis, N. A. Fungi.
North American Fungi. J. B. Ellis. Cent. i.–xi. Newfield and Philadelphia: 1878–1883.

Erb. Crit. Ital.
Erbario Crittogamico Italiano, per cura di G. de Notaris, Fr. Baglietto et Fr. Ardissone. Series 1. 24 fasc. Folio. Genova: 1858–1864.

Fckl., F. Rh.
L. Fuckel's Fungi Rhenani Exsiccati. Cent. 1–15, and supp. 4to. Wiesbaden: 1865.

Fries, Scl. Suec.
Scleromycetes Suecia Exsiccati. Elias Magnus Fries. Upsala.

Gardiner, exs.
250 Specimens of Mosses, Fungi, etc. By William Gardiner. Dundee: 1845–1848.

Karst., Fung. Fenn.
Fungi Fenniæ Exsiccati. P. A. Karsten. 7 cent. Helsingfors.

Klotzsch, H. M.
Herbarium vivum Mycologische Hefte. J. F. Klotzsch. 20 vols. 4to. Berlin: 1832, etc.

Kunze, Exs. Also *Kze. and Schm.*
Deutschlands Schwamme in getrockneten Examplaren. By C. F. Hall, I. C. Schmidt, and G. Kunze. Leipzig: 1815–1818.

——, *Fung. Sel.*
Fungi Selecti Exsiccati. Joanne Kunze. Islebiæ: 1876–1880.

Lasch in Klotzsch, Herb. Myco.
F. W. Lasch's contributions to Klolzsch's Herbarium vivum Mycologische Hefte.

Libert, Crypt. Ard.
Plantes Cryptogames des Ardennes. Madame Libert: 1830–1837.

Mazerio., Crypt. Gal.
See Desm. Crypt. Fr.

Moug. Exs., or Moug. and Nest.
J. B. Mougeot, C. Nestler, et W. P. Schimper, Stirpibus Cryptogamis Vogeso-Rhenanis. 15 fasc. 4to. Bruyerii Vogesorum: 1810–1864.

Phil., Elv. Brit.
Elvellacei Britannici. 4 fasc. 4to. Shrewsbury: 1874–1881.

Rabh., Fung. Eur.
Rabenhorst's Fungorum Europæorum Exsiccatorum. Cent. i.–xx. Dresden: 1861–1881.

Rabh., Herb. Myco.
Herbarium vivum Mycologicum. J. F. Klolzsch. Continued by Dr. Rabenhorst. Dresden: 1855–1860.

Rav., Fung. Am.
Fungi Americani Exsiccati. H. W. Ravenel. Edited by M. C. Cooke. Fasc. i.–viii. London: 1877.

——, *Fung. Carol.*
Fungi Caroliniani Exsiccati. H. W. Ravenel. 4 fasc. 4to. Charleston: 1852, etc.

Rehm, Asco.
Ascomyceten. Dr. Med. Rehm. Fasc. i.–xvii. Dresden: 1868–1885.

Roumg., Fung. Gal.
Fungi Selecti Gallici Exsiccati. M. C. Roumeguère. Cent. i.–xxxix. 4to. Toulouse: 1879–1886.

——, *Stirpes.*
Those specimens in the preceding work originally issued in Mougeot's work quoted above.

Sacc., Erb. Crit.
Erbario Crittogamico Italiano. P. A. Saccardo. Ser. 1. 24 fasc. Genova: 1858–1864. Ser. 2. 14 fasc. 1868–1879.

——, *Myco. Ven.*
Mycotheca Veneta. P. A. Saccardo. Cent. i.-xv. 4to. Patavii: 1874–1880.

Schm and Kze.
See Kunze, exs.

Sommf.
Plantæ Cryptogamicæ Norvegiæ. Christianus Sommerfelt. 4to. Lipsiæ: 1827.

Syd., Mycoth. Mar.
Mycotheca Marchica. Sydow and Zopf. 13 cent. Folio. Berol: 1880–1887.

Thum., Fung. Aus.
Fungi Austriaci Exsiccati. F. de Thumen 13 cent. 4to. Dresden and Bayreuth: 1871–1875.

——, *Herb. Myco.*
Herbarium Mycologicum Æconomicum. F. de Thumen. 14 fasc: 1873–1879.

——, *Mycoth. Univ.*
Mycotheca Universalis. F. de Thumen. 23 cent. 4to. Bayreuth: 1875–1880.

Wartm. and Sch.
Herbarium Schweizericher Kryptogamen. Fasc. i.–xii. St. Gallen: 1862–1869.

Welw. Crypt. Lusit.

West and Wall.
Herbier Cryptogamique Belge. Fasc. 21–28. 4to. 1855–1859.

Winter, Fungi Eur.
Fungi Europæi et extra Europæi Exsiccati. Klotzschii Herbarii vivi Mycologici continuatio. Editio nova. Cura Dr. G. Winter. Dresden: 1881.

Zopf. and Syd. Mycoth. Mar.
Zopf et Sydow Mycotheca Marchica. Berlin: 1880–1884.

DESCRIPTION OF PLATES.

PLATE I.

Fig. 1.—*a*, *Morchella esculenta*, nat. size; *b*, a section of the same; *c*, an ascus and paraphyses; *d*, sporidia. *c* and *d* × 400 times.

Fig. 2.—*a*, *Gyromitra esculenta*, nat. size; *b*, section of the same; *c*, an ascus and a paraphysis; *d*, a sporidium. *c* and *d* × 400 times.

Fig. 3.—*a*, *Helvella lacunosa*, nat. size; *b*, a section of the same, *c*, an ascus with two paraphyses; *d*, three sporidia. *c* and *d* × 400 times.

Fig. 4.—*a*, *Verpa rufipes*, nat. size; *b*, a section of the same; *c*, an ascus and a paraphysis; *d*, sporidia; *e*, cellular filament from the epidermis. *c*, *d*, and *e* × 400 times.

PLATE II.

Fig. 5.—*a*, *Leotia circinans*, nat. size; *b*, section of the same; *c*, an ascus with three paraphyses; *d*, two sporidia. *c* and *d* × 400 times.

Fig. 6.—*a*, *Mitrula paludosa*, nat. size; *b*, section of the upper part; *c*, an ascus; *d*, three sporidia. *c* and *d* × 400 times.

Fig. 7.—*a*, *Spathularia flavida*, nat. size; *b*, section of the same; *c*, an ascus with three paraphyses; *d*, two filiform sporidia. *c* and *d* × 400 times.

Fig. 8.—*a*, *Leptoglossum viride*, nat. size; *b*, section of the same; *c*, an ascus with two paraphyses; *d*, sporidia. *c* and *d* × 400 times.

Fig. 9.—*a*, *Geoglossum hirsutum*, nat. size; *b*, an ascus with two hooked paraphyses; *c*, a sporidium; *d*, one of the black rigid hairs from the hymenium intermixed with the asci. *b*, *c*, and *d* × 400 times.

Fig. 10.—*a*, *Rhizina undulata*, nat. size; *b*, a section of the same, showing the root-like fibrillæ: *c*. an ascus: *d*. the fusiform sporidia. *c* and *d* × 400 times.

Plate III.

Fig. 11.—*a*, *Peziza acetabulum*, nat. size; *b*, a section of the same; *c*, an ascus with a paraphysis; *d*, three sporidia. *c* and *d* × 400 times.

Fig. 12.—*a*, *Peziza cupularis*, nat. size; *b*, a section of the same; *c*, an ascus with a paraphysis; *d*, three sporidia. *c* and *d* × 400 times.

Fig. 13.—*a*, *a*, *Peziza pleurota*, nat. size; *b*, section of the same; *c*, an ascus and a paraphysis; *d*, four sporidia. *c* and *d* × 400 times.

Fig. 14.—*a*, *Peziza aurantia*, nat. size; *b*, section of the same; *c*, an ascus with a paraphysis; *d*, sporidia. *c* and *d* × 400 times.

Fig. 15.—*a*, *a*, *a*, *Peziza trachycarpa*, nat. size; *b*, a section; *c*, an ascus and a paraphysis; *d*, four sporidia. *c* and *d* × 400 times.

Plate IV.

Fig. 16.—*a*, *Peziza succosa*, two cups, nat. size; *b*, a section of a cup; *c*, an ascus with two paraphyses; *d*, four sporidia, the two lower more mature. *c* and *d* × 400 times.

Fig. 17.—*a*, *a*, *Peziza radula*, nat. size; *b*, a section of a cup; *c*, an ascus with a paraphysis; *d*, four sporidia. *c* and *d* × 400 times.

Fig. 18.—*a*, *a*, *a*, *Peziza lividula*, nat. size; *b*, a section of a cup; *c*, an ascus with a paraphysis; *d*, three sporidia. *c* and *d* × 400 times.

Fig. 19.—*a*, *Peziza Crouani*, nat. size; *b*, a cup magnified 5 times; *c*, a section of the same; *d*, an ascus with a paraphysis; *e*, four sporidia. *d* and *e* × 400 times.

Fig. 20.—*a*, *Peziza rutilans*, two cups, nat. size; *b*, a section of a cup; *c*, an ascus with a paraphysis; *d*, four sporidia. *c* and *d* × 400 times.

Fig. 21.—*a*, *Peziza corallina*, a group the nat. size; *b*, *b*, two cups slightly magnified; *c*, a section of a cup also slightly magnified; *d*, an ascus with a paraphysis; *e*, two sporidia. *d* and *e* × 400 times.

Plate V.

Fig. 22.—*a*, *Peziza omphalodes*, a group the nat. size; *b*, a group slightly magnified; *c*, a cup more highly magnified; *d*, a section of the latter, both showing the white mycelium from which they spring; *e*, an ascus with paraphyses; *f*, four sporidia. *e* and *f* × 400 times.

Fig. 23.—*a*, *a*, *Psilopezia*, nat. size; *b*, a section of the upper one; *c*, ascus with a paraphysis; *d*, seven sporidia. *c* and *d* × 400 times.

Fig. 24.—*a*, *Hymenoscypha sclerotiorum*, a group the nat. size, with the sclerotia from which they arise; *b*, a section of one; *c*, an ascus with a paraphysis; *d*, five sporidia. *c* and *d* × 400 times.

Fig. 25.—*a*, *Hymenoscypha pseudo-tuberosa*, a group the nat. size, arising from a decayed acorn; *b*, a section of a cup slightly magnified; *c*, two asci with paraphyses; *d*, six sporidia, showing their variable size. *c* and *d* × 400 times.

Fig. 26.—*a*, *Hymenoscypha coronata*, a group the nat. size; *b*, two cups magnified, one being a section; *c*, an ascus with a paraphysis; *d*, three sporidia. *c* and *d* × 400 times.

Fig. 27.—*a*, *Hymenoscypha Broomei*, a group the nat. size; *b*, three cups magnified; *c*, a section of a cup; *d*, two asci; *e*, six sporidia. *d* and *e* × 400 times.

Fig. 28.—*a*, *Chlorosplenium æruginosum*, a group the nat. size; *b*, two cups slightly magnified; *c*, a section of a cup; *d*, an ascus with paraphyses; *e*, seven sporidia. *d* and *e* × 400 times.

Fig. 29.—*a*, *Belonidium culmicolum*, a group the nat. size; *b*, two cups magnified 10 times; *c*, a section of a cup magnified 10 times; *d*, an immature and a mature ascus with paraphyses; *e*, four sporidia, one of which shows a gelatinous envelope not unfrequently seen to surround them. *d* and *e* × 400 times.

Fig. 30.—*a*, *Helotium ferruginosum*, a group the nat. size; *b*, three cups slightly magnified; *c*, a section of a cup slightly magnified; *d*, two asci with paraphyses; *e*, six sporidia in various stages of development. *d* and *e* × 400 times.

Fig. 31.—*a*, *Helotium claro-flavum*, a group the nat. size; *b*, a group slightly magnified; *c*, a section of a cup also magnified; *d*, an ascus with paraphyses; *e*, seven sporidia in various stages of development. *d* and *e* × 400 times.

Plate VI.

Fig. 32.—*a*, *Mollisia cinerea*, a group the nat. size; *b*, a group seen from above, slightly magnified; *c*, two cups viewed sideways, also magnified; *d*, a section of a cup; *e*, an ascus with paraphyses; *f*, twelve sporidia, representing the variation in size and form in the same individual. *e* and *f* × 400 times.

Fig. 33.—*a*, *Mollisia nervisequia*, a group the nat. size on a fragment of a leaf of *Plantago*; *b*, two cups magnified 20 times, and in two stages of development; *c*, a section of the younger one; *d*, an ascus with paraphyses; *e*, six sporidia. *d* and *e* × 400 times.

Fig. 34.—*a*, *Mollisia dilutella*, a group the nat. size; *b*, three cups magnified, showing the several stages of growth; *d*, three asci; *e*, eight sporidia, showing the degree of variability of size and shape. *d* and *e* × 400 times.

Fig. 35.—*a*, *Mollisia Bullii*, a group the nat. size; *b*, a group magnified; *c*, a section of a cup also magnified; *d*, two asci; *e*, seven sporidia, showing variation of size. *d* and *e* × 400 times.

Fig. 36.—*a*, *Mollisia cerastiorum*, a fragment of the host plant

bearing four cups, nat. size; *b, c*, three cups magnified, the lower one seen from above; *d*. a section of a cup also magnified; *e*, two asci; *f*, nine sporidia; *e* and *f*, × 400 times.

Fig. 37.—*a*, *Mollisia peristomialis*, a group the nat. size; *b*, three cups magnified 20 times; *c*, a section of a cup, showing the scarcely depressed hymenium; *d*, two of the teeth magnified; *e*, three asci; *f*, four sporidia. *d, e*, and *f* × 400 times.

Fig. 38.—*a, a*, *Lachnea radiculata*, nat. size; *b*, a section of a cup; *c*, one of the nearly colourless hairs from the exterior of the cup; *d*, an ascus with paraphyses; *e*, four sporidia in several stages of growth. *c, d*, and *e* × 400 times.

Fig. 39.—*a*, *Lachnea sepulta*, one mature cup and three young ones, nat. size; *b*, a section of a cup; *c*, a group of hairs from the exterior of the cup; *d*, an ascus with a paraphysis; *e*, three sporidia, the lower one more advanced in growth. *c, d*, and *e* × 400 times.

Plate VII.

Fig. 40.—*a*, *Lachnea melastoma*, nat. size, showing the black strigose filaments from which it springs; *b*, section of a cup; *c*, a group of the strigose filaments from the base; *d*, an ascus with a paraphysis; *e*, four sporidia. *c, d*, and *e* × 400 times.

Fig. 41.—*a*, *Lachnea trechispora*, three cups in different stages of growth, nat. size; *b*, a section of a cup; *c*, a group of hairs from the exterior of the cup (the bent one is so represented to save space); *d*, an ascus with a paraphysis; *e*, two sporidia. *c, d*, and *e* × 400 times.

Fig. 42.—*a*, *Lachnea Cornubiensis*, two cups the nat. size; *b*, a section of a cup; *c*, a group of hairs from the exterior of the cup; *d*, an ascus containing eight sporidia, with a paraphysis. *c* and *d* × 400 times.

Fig. 43.—*a*, *Lachnella diplocarpa*, a group the nat. size; *b*, a cup magnified; *c*, a section of the same; *d*. one of the hairs from the exterior of the cup; *e*, asci paraphyses, and filaments surmounted by fusiform spores (?); *f*, six sporidia in various conditions of development; *g*, one of the filaments, surmounted, by its fusiform spore, viewed separately. *d, e, f*, and *g* × 400 times.

Fig. 44.—*a*, *Lachnella cerina*, a group the nat. size; *b*, three cups in different stages of growth, magnified; *c*, section of a cup; *d*, hairs from near the margin of a cup; *e*, an ascus with two acerose paraphyses; *f*, seven sporidia. *d, e*, and *f* × 400 times.

Plate VIII.

Fig. 45.—*a*, *Lachnella cupressi*, nat. size; *b*, two cups slightly magnified; *c*, a section of a cup; *d*, the villose hairs from the exterior of a cup; *e*, ascus with paraphyses; *f*, six sporidia. *d, e*, and *f* × 400 times.

Fig. 46.—*a*, *Lachnella bicolor*, a group the nat. size; *b*, three cups enlarged, in different stages of growth; *c*, section of a cup; *d*, three hairs from the exterior of a cup; *e*, an ascus with two acerose paraphyses; *f*, five sporidia. *d*, *e*, and *f* × 400 times.

Fig. 47.—*a*, *Lachnella pteridis*, a group the nat. size; *b*, two cups enlarged, one young, the other more mature; *c*, a section of a cup; *d*, a group of hairs from the exterior of a cup; *e*, an ascus with a paraphysis; *f*, seven sporidia. *d*, *e*, and *f* × 400 times.

Fig. 48.—*a*, *Lachnella hyalina*, a group the nat. size; *b*, two cups in different stages of growth, magnified; *c*, a section of a cup; *d*, two asci; *e*, six sporidia. *d* and *e* × 400 times.

Fig. 49.—*a*, *Lachnella rufo-olivacea*, the nat. size; *b*, a cup magnified 10 times; *c*, a section of a cup; *d*, loose brown cells from the exterior of a cup; *e*, two asci, the one filled with coarse granular protoplasm, the other in which the sporidia are matured, with a clavate paraphysis; *f*, four sporidia in different stages of development, the pseudo-septate ones being the most mature.

Fig. 50.—*a*, *Tapesia aurelia*, a group the nat. size seated on a fragment of an oak-leaf; *b*, two cups enlarged, of different ages, showing the white tapesium from which they arise; *c*, a section of a cup; *d*, a portion of the tapesium; *e*, asci and paraphyses; *f*, seven sporidia in different stages of growth. *d*, *e*, and *f* × 400 times.

Fig. 51.—*a*, *Desmazierella acicola*, three cups nat. size; *b*, section of a cup magnified, showing the hairy hymenium; *c*, one of the rigid hairs of the exterior; *d*, an ascus; *e*, a bundle of paraphyses divided at the top in the form of bristle-like points, which rise above the surface of the hymenium; *f*, four sporidia. *d*, *e*, and *f* × 400 times.

Fig. 52.—*a*, *Pirottæa vectis*, a group the nat. size; *b*, two cups magnified; *c*, a section of a mature cup; *d*, a group of the rigid bristles from the margin of a cup; *e*, asci and paraphyses; *f*, five sporidia in different stages of growth, showing their variable shape. *d*, *e*, and *f* × 400 times

Plate IX.

Fig. 53.—*a*, *Boudiera areolata*, a group the nat. size: *b*, *b*, two cups magnified; *c*, a section of a cup; *d*, an ascus with paraphyses; *e*, sporidia. *d* and *e* × 400 times.

Fig. 54.—*a*, *Ascobolus viridis*, three cups the nat. size; *b*, a section of a cup; *c*, an ascus with paraphyses; *d*, three sporidia.

Fig. 55.—*a*, *Saccobolus violaceus*, a group the nat. size; *b*, a group slightly magnified; *c*, a section of a cup; *d*, asci and paraphyses; *e*, eight sporidia removed from the ascus and still enclosed in a cell, which was developed within the parent ascus; *f*, three sporidia detached from the group. *d*, *e*, and *f* × 400 times.

Fig. 56.—*a*, *Thecotheus Pelletieri*, a group the nat. size; *b*, two cups magnified; *c*, an ascus filled with sporidia; *d*, the summit of an

ascus, showing the operculum open through which the sporidia have escaped; *e* and *f*, sporidia in different stages of growth, the one at *f* being surrounded by a gelatinous envelope. *c*, *d*, *e*, and *f* × 400 times.

Fig. 57.—*a*, *Ryparobius Cookei*, a group the nat. size; *b*, a group slightly magnified; *c*, a section more highly magnified; *d*, an ascus and paraphyses; *e*, eight sporidia, showing variation in size and shape. *d* and *e* × 400 times.

Fig. 58.—*a*, *Ascophanus testaceus*, a group the nat. size seated on a piece of old sacking; *b* and *c*, cups magnified; *d*, an ascus with a paraphysis; *e*, six sporidia. *d* and *e* × 400 times.

Plate X.

Fig. 59.—*a*, *Bulgaria inquinans*, a group the nat. size seated on a piece of wood; *b*, a section of a cup; *c*, two asci in different stages of growth with paraphyses; *d*, sporidia removed from an ascus. *c* and *d* × 400 times.

Fig. 60.—*a*, *Vibrissea truncorum*, a group the nat. size; *b*, a section somewhat enlarged; *c*, an ascus and paraphyses; *d*, a filiform sporidium removed from an ascus. *c* and *d* × 400 times.

Fig. 61.—*a*, *Vibrissea Guernisaci*, a group the nat. size; *b*, one cup enlarged; *c*, section of a cup; *d*, ascus and paraphyses; *e*, a filiform sporidium detached from an ascus. *d* and *e* × 400 times.

Fig. 62.—*a* and *b*, *Ombrophila clavus*, in two forms, nat. size; *c*, section of a larger specimen; *d*, ascus with paraphyses; *e*, six sporidia. *d* and *e* × 400 times.

Fig. 63.—*a*, *Calloria vinosa*, a group the nat. size; *b*. two cups magnified; *c*, a section; *d*, two asci with paraphyses having globose heads; *e*, seven sporidia, showing variation in their form and size. *d* and *e* × 400 times.

Fig. 64.—*a*, *Encœlia fascicularis*, a group the nat. size; *b*, a section of a cup; *c*, two asci, the one immature, the other mature; *d*, four sporidia. *c* and *d* × 400 times.

Fig. 65.—*a*, *Dermatea cinnamomea*, several clusters the nat. size; *b*, a cluster breaking through the epidermis of the bark, magnified; *c*, a section of a cluster more highly magnified; *d*, an ascus and paraphysis; *e*, six sporidia in different stages of development, those with septa being most mature. *d* and *e* × 400 times.

Fig. 66.—*a*, *Cenangium Prunastri*, the nat. size, bursting through the epidermis of the matrix in tranverse elongated clusters; *b*, a cluster of ascigerous cups magnified; *c*, showing another cluster, and at a little distance, on the same piece of wood, a cluster of awl-shaped pycnidia; *d*, a section of a cluster, showing the pycnidia associated with the acigerous cups; *e*, a fragment of the interior of a pycnidium, showing the filiform sterigmata, on the summits of which are produced the stylospores *f*; *g*, three asci, one of which is immature, surrounded with the adherent paraphyses; *h*, nine sporidia. *e*, *f*, *g*, and *h* × 400 times.

Plate XI.

Fig. 67.—*a*, *Tympanis conspersa*, four clusters which have burst through the bark, the natural size; *b*, a cluster with spermogonia intermixed, slightly magnified; *c*, a section of a cluster; *d*, a portion of the interior of a spermogonium, with the filiform sterigmata; *e*, the spermatia produced on the sterigmata; *f*, asci mature and immature, surrounded with the adherent paraphyses; *g*, a number of sporidia, showing their variation in size and form. *d* and *g* × 400 times.

Fig. 68.—*a*, *Crumenula urceoliformis*, several cups on *Vaccinium* twigs, the natural size; *b*, a cup magnified; *c*, a section of the same; *d*, an ascus with paraphyses; *e*, two filiform sporidia; *f*, stylospores on their sterigmata. *d*, *e*, and *f* × 400 times.

Fig. 69.—*a*, *Ephelis Rhinanthi*, nat. size; *b*, mature cups magnified; *c*, section of a cup; *d*, an ascus with a paraphysis; *e*, four sporidia; *f*, spermatia with their sterigmata. *d*, *e*, and *f* × 400 times.

Fig. 70.—*a*, *Patellaria clavispora*, a group the nat. size; *b*, two cups magnified; *c*, section of a cup; *d*, an ascus with several paraphyses; *e*, sporidia, showing stages of growth. *d* and *e* × 400 times.

Fig. 71.—*a*, *Heterosphæria patella*, nat. size; *b*, a cup magnified; *c*, a section of a cup that has not yet split open at the top; *d*, an ascus and paraphyses; *e*, five sporidia; *f*, stylospores. *d*, *e*, and *f* × 400 times.

Fig. 72.—*a*, *Laquearia sphæralis*, a group the nat. size; *b*, a single receptacle seen from above, enlarged; *c*, a section of a receptacle more highly magnified; *d*, an ascus with paraphyses; *e*, five sporidia. *d* and *e* × 400 times.

Fig. 73.—*a*, *Propolis versicolor*, the nat. size; *b*, a single receptacle magnified; *c*, a section of the same; *d*, an ascus with paraphyses; *e*, seven sporidia removed from an ascus. *d* and *e* × 400 times.

Plate XII.

Fig. 74.—*a*, *Schmitzomia atro-alba*, the nat. size; *b*, three receptacles magnified; *c*, section of a receptacle, showing how it is immersed in the matrix; *d*, an ascus and paraphyses; *e*, a filiform sporidium. *d* and *e* × 400 times.

Fig. 75.—*a*, *Stictis pallida*, nat. size; *b*, three receptacles magnified; *c*, a section of a receptacle; *d*, an ascus with paraphyses; *e*, six sporidia. *d* and *e* × 400 times.

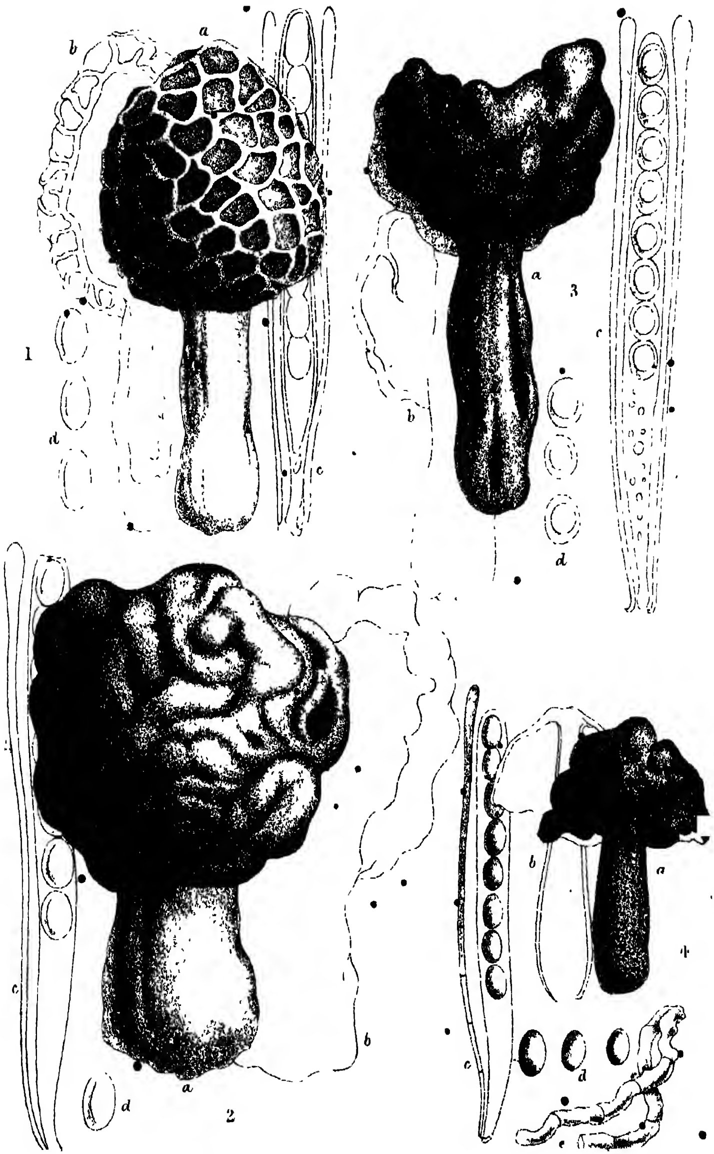
Fig. 76.—*a*, *Phacidium striatum*, the nat. size; *b*, two receptacles magnified, the one just splitting, the other having fully opened; *c*, a section; *d*, two mature asci with paraphyses; *e*, six sporidia in different stages of development. *d* and *e* × 400 times.

Fig. 77.—*a*, *Trochila craterium*, on a fragment of a leaf, the nat.

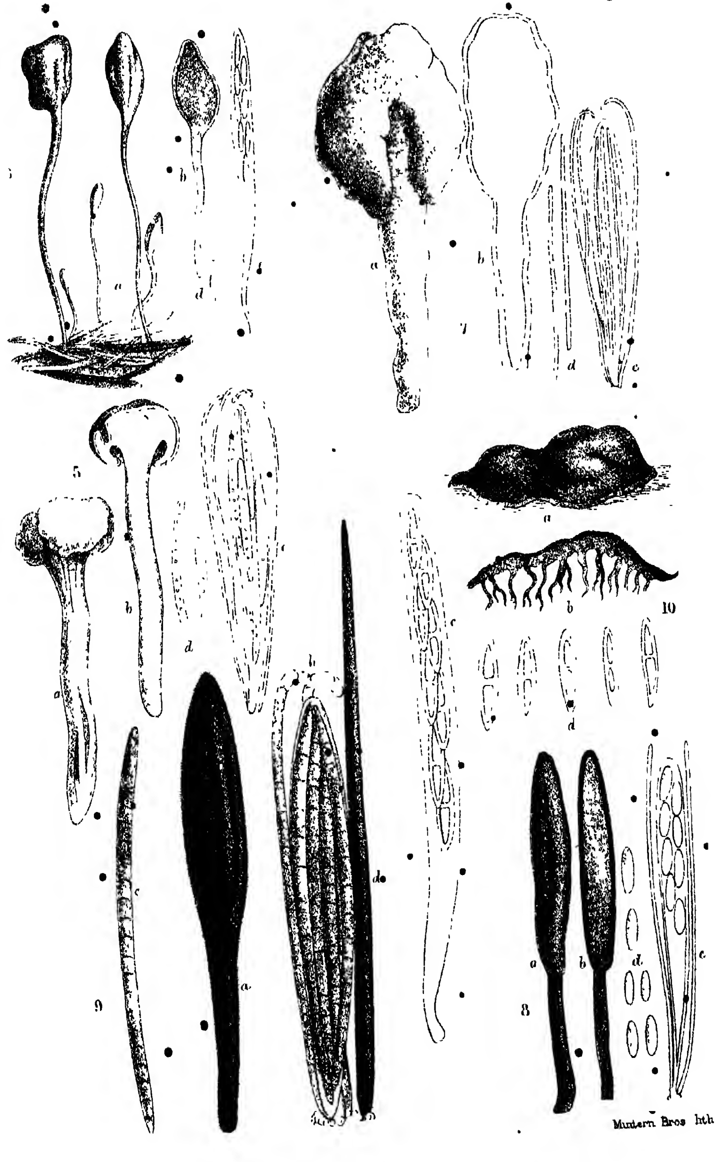
size; *b*, four receptacles magnified; *c*, sections of the same; *d*, an ascus with paraphyses; *e*, two sporidia. *d* and *e* × 400 times.

Fig. 78.—*a*, *Stegia Ilicis*, on a portion of a holly-leaf, nat. size; *b*, a receptacle magnified, showing the upper half of the perithecium splitting and becoming detached and exposing the hymenium; *c*, an ascus; *d*, five sporidia. *c* and *d* × 400 times.

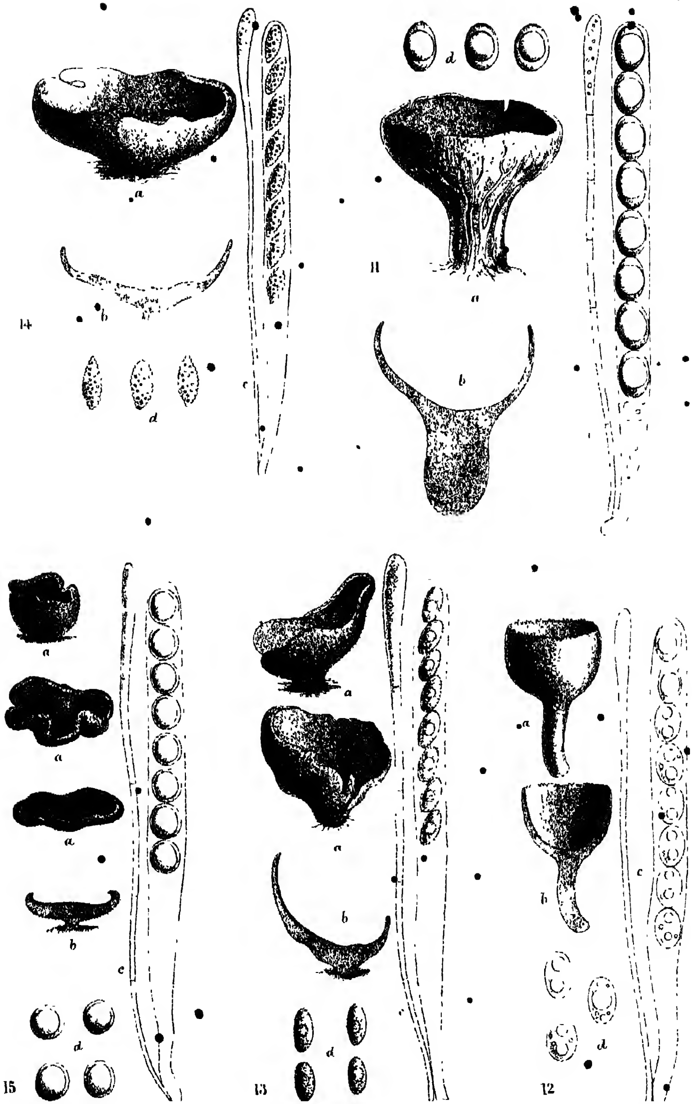
Fig. 79.—*a*, *Ascomyces Potentillæ*, on a portion of a branch of the host plant, which it has much enlarged; *b*, *b*, a portion of the cellular tissue of the host plant, showing the mycelium of the *Ascomyces* ramifying between the cells of the epidermis and throwing up asci *c*, *c*, through the cuticle; *f*, sporidia. *b*, *b*, *c*, *c*, and *f* × 400 times.



1
a
b
c
d
2
a
b
c
d
3
a
b
c
d
4
a
b
c
d
e

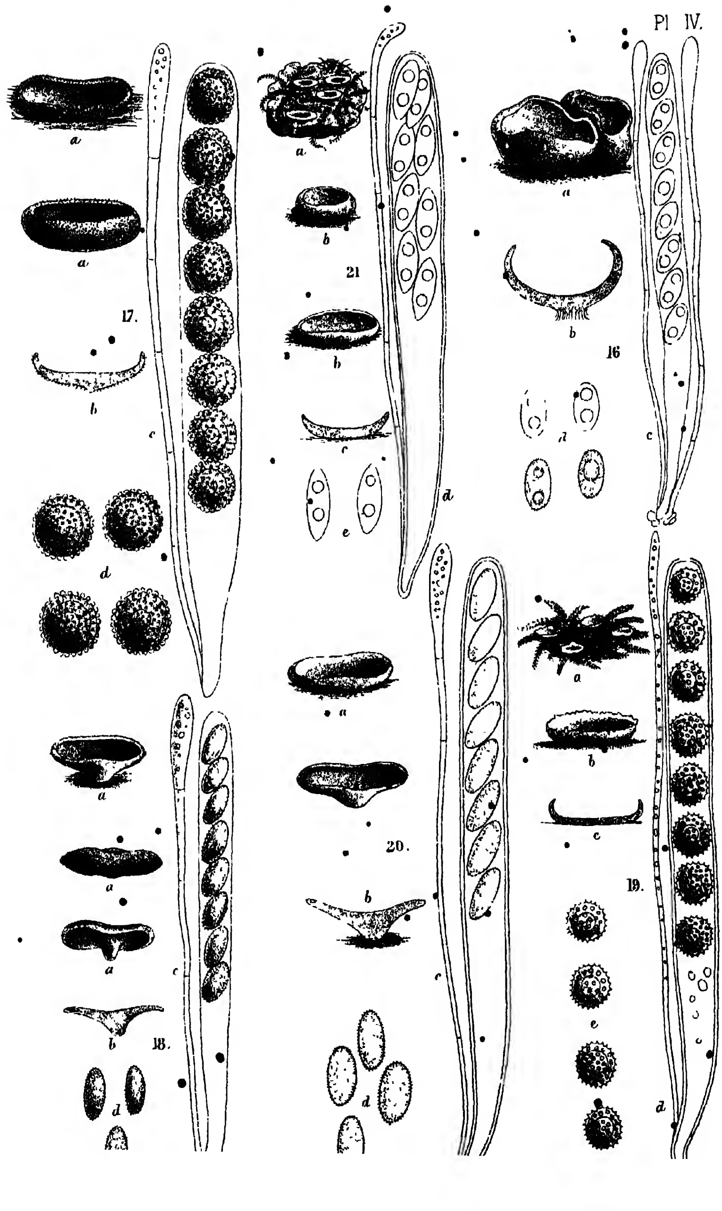


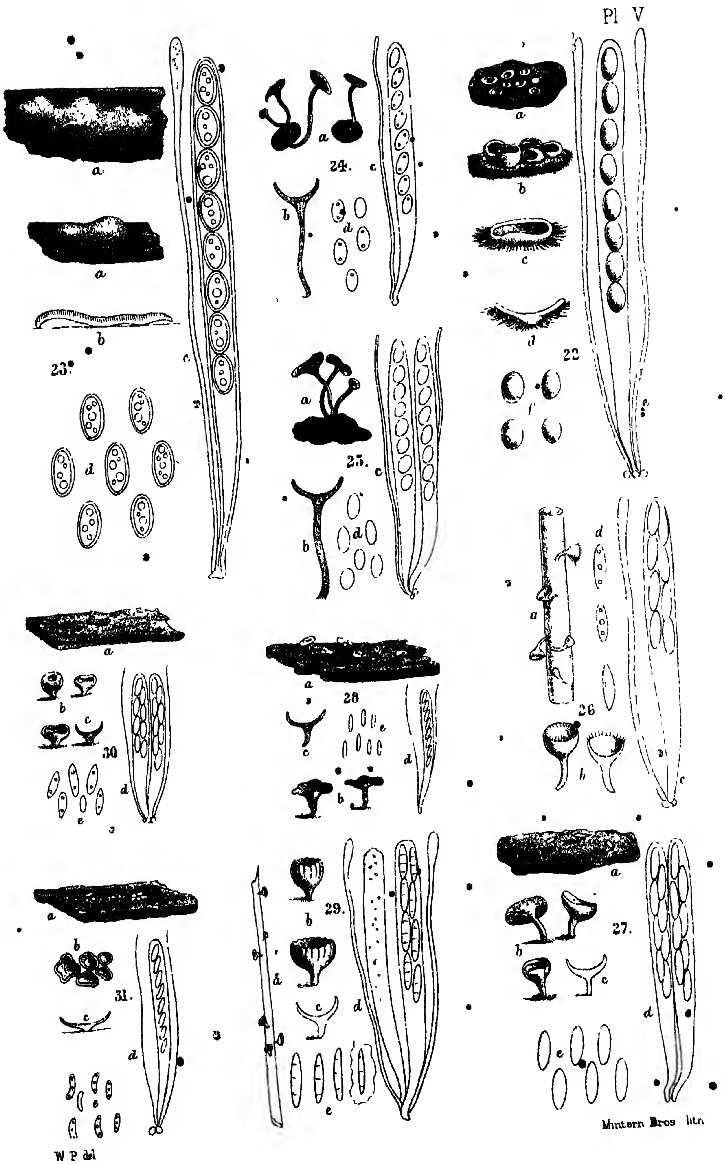
Mintern Bros lith



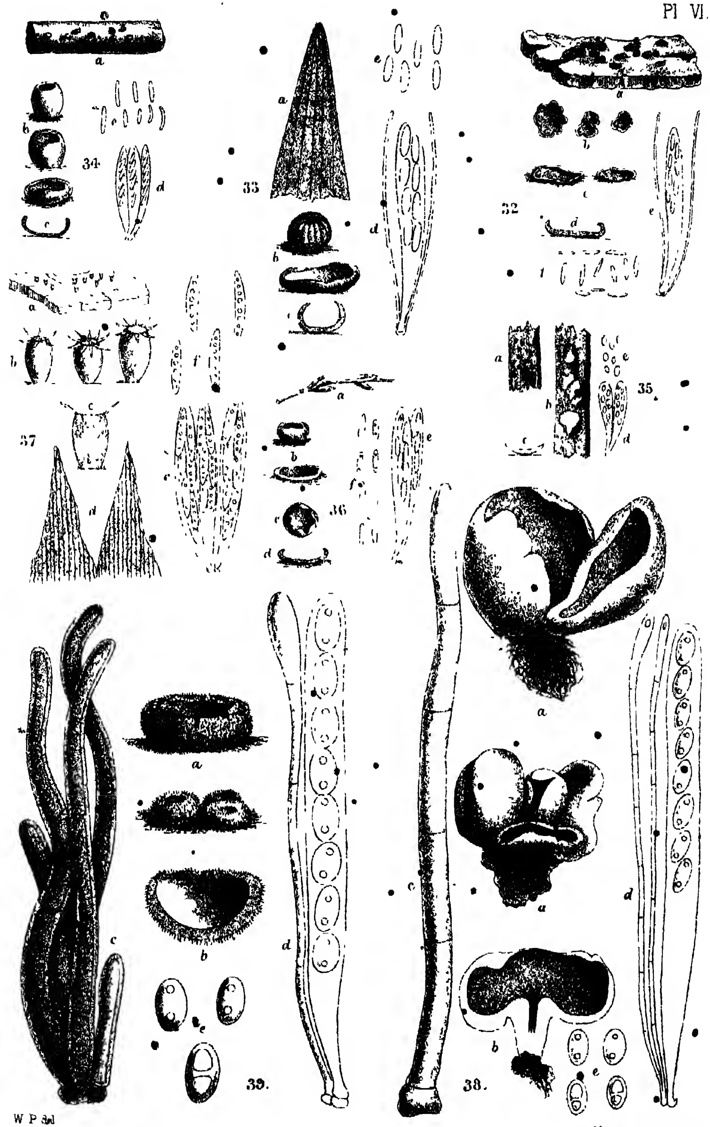
Mintern Bros. lith.

Pl IV.



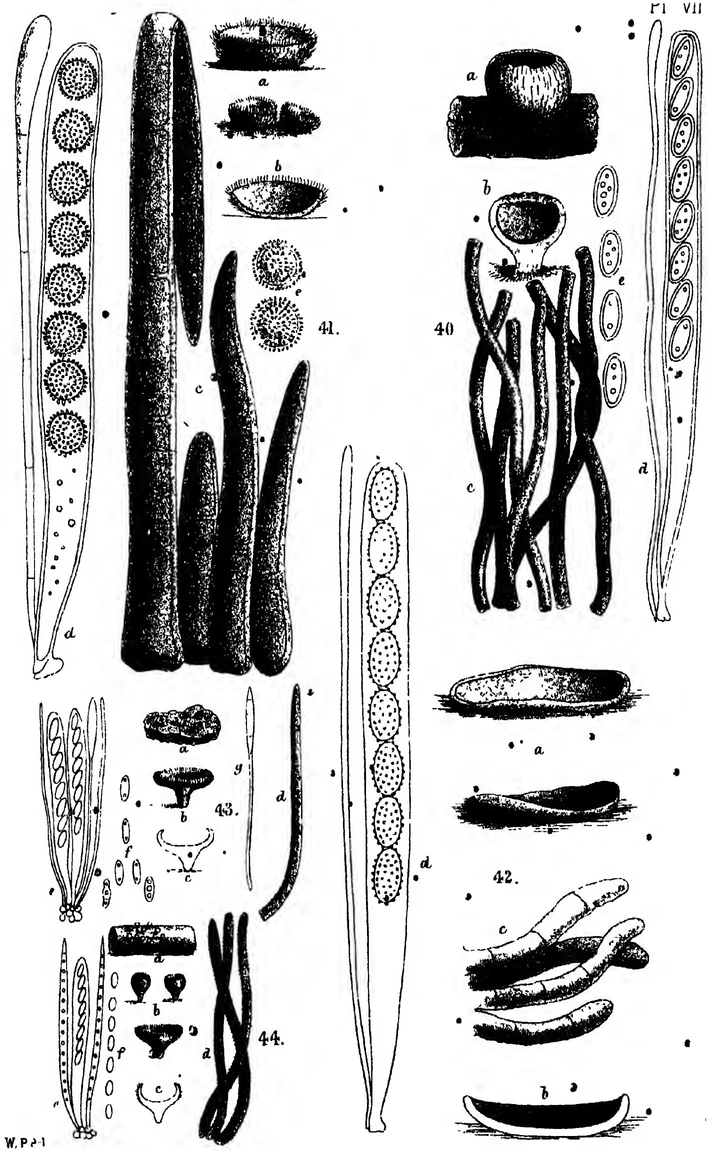

Pl V
23.
24.
25.
22
26
28
30
29.
31.
27.
W P del
Mintern Bros lith

Pl VI.

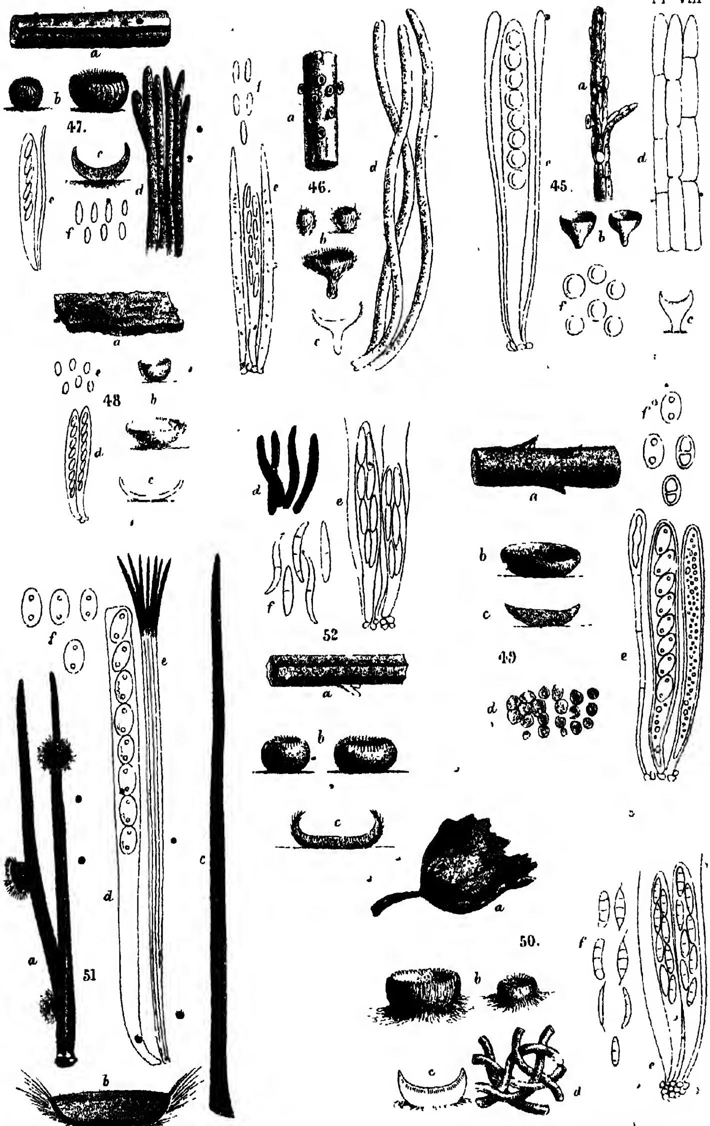


W P del

Mintern Bros lith


a
b
c
d
e
41.
40
42.
43.
44.
f
g
W. P. del.

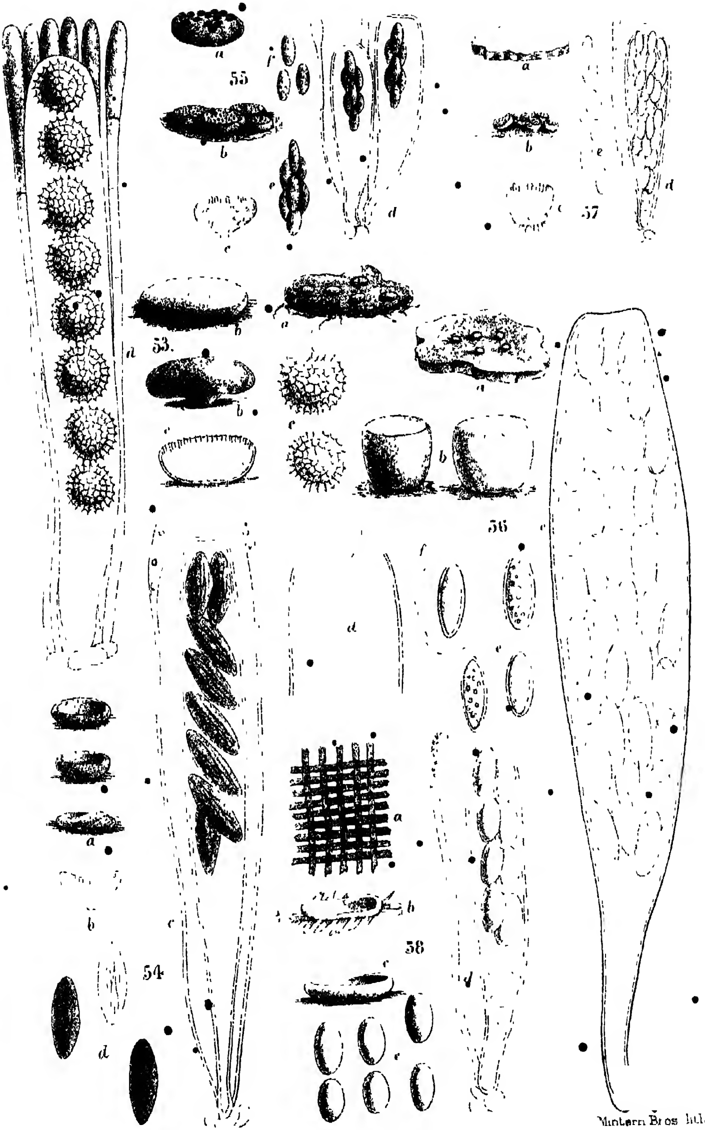
Pl VIII



W P del

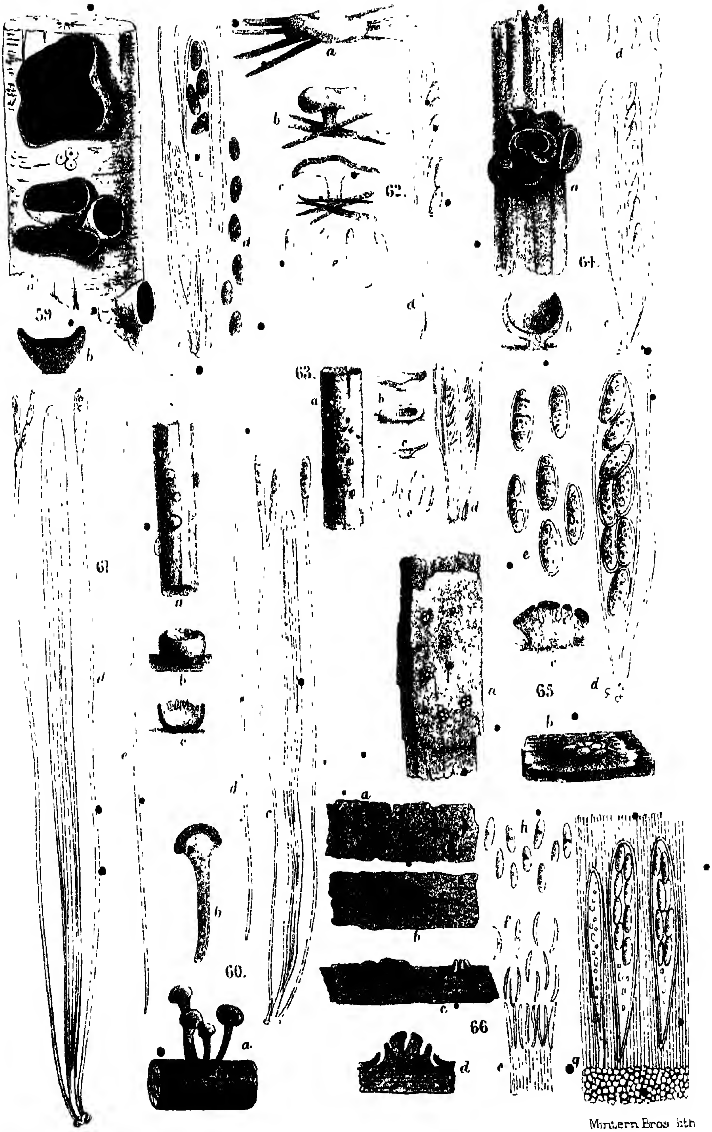
Mintern Bros lith

Pl. IX



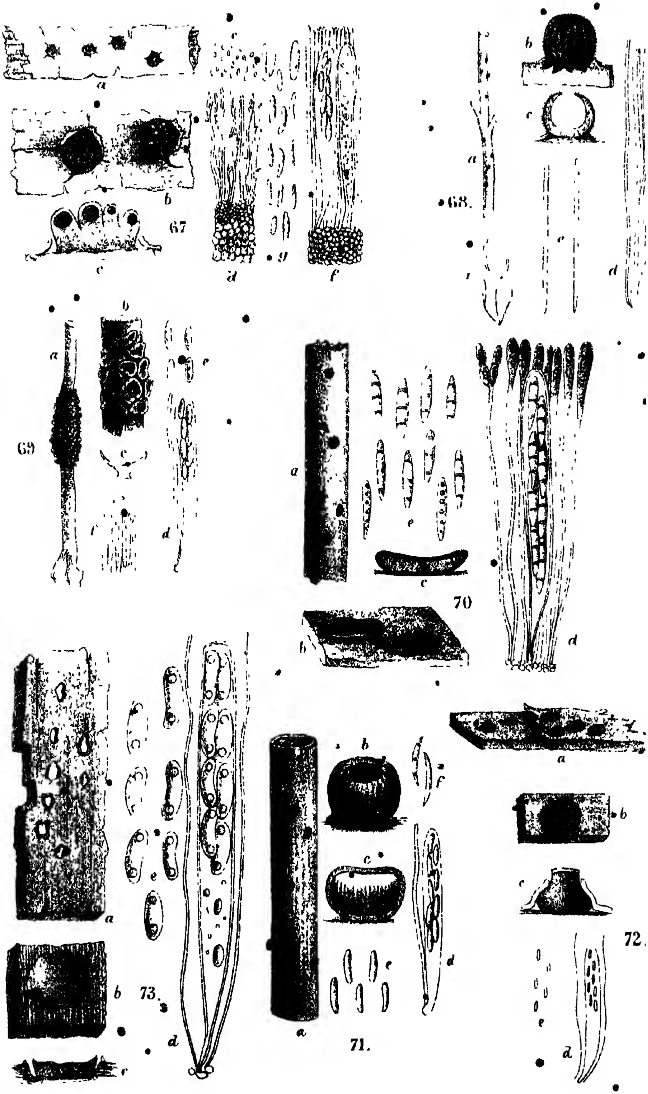
Mintern Bros lith.

Pl. X



Mintern Bros lith

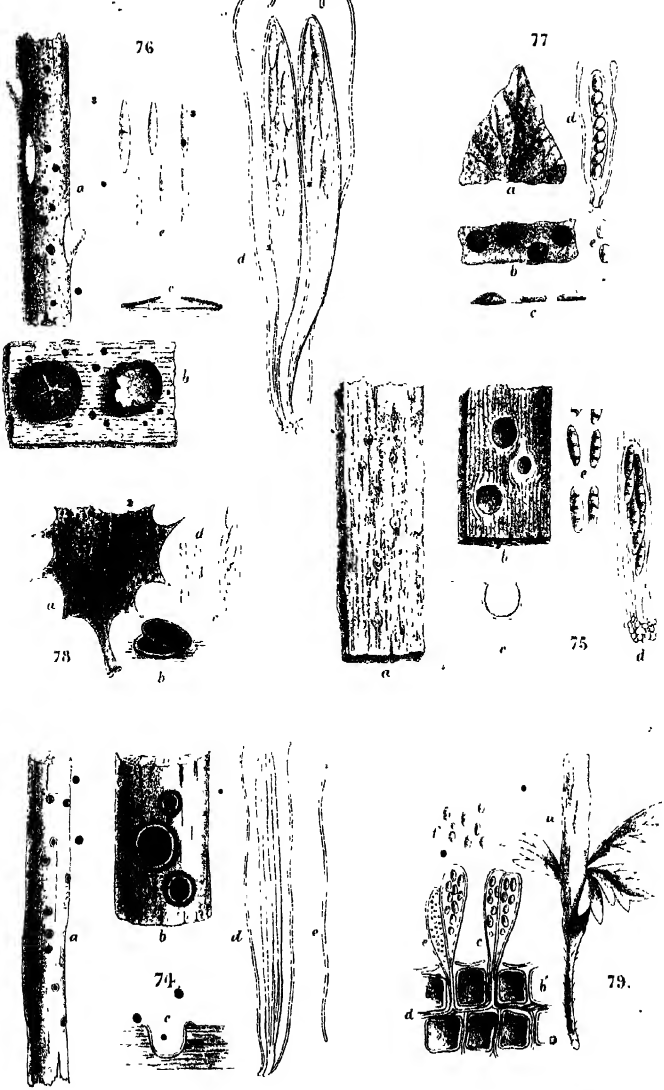
Pl. XI



W P del

Mint. ... Bro. lith.

Pl XI



Mintern Bros lith

INDEX.